NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

AN EVALUATION OF COSTS AND BENEFITS OF THE NAVY'S DRUG PREVENTION POLICIES

by

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March 2001

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REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE March 2001	3. REPORT TYPE AND DATES COVERED Master's Thesis

4. TITLE AND SUBTITLE An Evaluation of Costs and Benefits of The Navy's Drug Prevention Policies	5. FUNDING NUMBERS
6. AUTHOR (S) McCrea, Mary Jane Osmeña Hey, Markus	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000	8. PERFORMING ORGANIZATION REPORT NUMBER
SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the U.S. Department of Defense or the U.S. Government.

12a. DISTRIBUTION / AVAILABILITY STATEMENT	12b. DISTRIBUTION CODE
Approved for public release; distribution is unlimited.	

13. ABSTRACT *(maximum 200 words)*

This thesis evaluates the costs and benefits of the Navy's drug prevention policies. Benefits stem from both deterrence and detection effects of the policies. By using data from the National Household Survey on Drug Abuse, and Department of Defense Survey of Health Related Behavior Among Military Personnel, the existence and magnitude of the deterrence effect is estimated. The gross benefits of the zero tolerance policy are calculated based on the costs avoided by deterring and detecting users. These benefits are compared to the total costs of the drug prevention program, including replacement costs of discharged personnel, and administrative costs. Sensitivity analysis suggests that, under reasonable assumptions about the key parameters, the program does not generate positive net benefits. It is recommended that an analysis of the cost-effectiveness of a rehabilitation program for positive drug testers be conducted.

SUBJECT TERMS Deterrence Effect, Detection Effect, Replacement Costs, Continuation Rates, Zero Tolerance	15. NUMBER OF PAGES 184
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

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AN EVALUATION OF COSTS AND BENEFITS OF THE NAVY'S DRUG PREVENTION POLICIES

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
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ACKNOWLEDGEMENTS

First and foremost, we would like to thank our families for their enduring patience and support during our time here at the Naval Postgraduate School. Without you by our sides, we sincerely could not have realized all our goals in the United States and German Navy. To Dr. Stephan L. Mehay and Dr. Natalie J. Webb, we extend our deep appreciation for your challenge, insight, guidance, and personal commitment to the process of learning and writing this thesis. To Mr. Wolfgang Milczewsky, Space and Naval Warfare Systems Command, and Ms. Ann Hamza, Defense Manpower Data Center, thank you so much for your assistance in molding the raw data needed for our research. In addition we would like to thank Melissa Potter and Dennis Mar for their help and support in mastering SAS. We would also like to extend our thanks to CDR Mark H. Dye, Naval Center for Cost Analysis, for his guidance in the use of COMET. Last but not least the authors would like to thank Ms. Abigail Grey, DynMeridian, for providing us with the continuation rates.

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I. INTRODUCTION

A. ENVIRONMENT

"Let us not forget who we are. Drug abuse is a repudiation of everything America is."

President Ronald Reagan

Many people believe that a central cause of our social ills is the abuse of drugs and alcohol. And despite all the extensive public campaigns, like the "This is your brain on drugs" television spot that graphically explains the physical and psychological consequences of drug abuse on one's health, family, and economic well-being, people continue to engage in some form of illegal drug use. The military is no exception.

The first indication of a real and threatening drug abuse problem in the military arose during the late stages of the Vietnam War, when drug abuse was widespread (as high as 50 percent in some units). [Ref. 1] In 1981 the drug abuse problem rose to the forefront of the Navy's consciousness due to a tragic airplane crash aboard the carrier USS NIMITZ, in which 14 sailors were killed. A later autopsy revealed the evidence of marijuana use among

six of the 13 sailors and nonprescription antihistamine use by the pilot. [Ref. 2]

The U.S. military, a mirror image of society and its values, quickly set the agenda that drug use is incompatible with the way "we do business" in the military. Therefore, the Department of Defense (DoD) implemented a "zero tolerance" drug policy in 1982, which remains today as the cornerstone of its prevention program. The system is designed to deter drug use by service members while promoting readiness within the operational ranks. After all, drug use is a national security concern that not only affects the Department of Defense, but ultimately American society as a whole. When service members engage in any sort of drug activity, they threaten their readiness to defend our nation at a moment's notice.

B. OBJECTIVES

This thesis examines the costs and effectiveness of the Navy's drug prevention program. One component of the analysis is to analyze the deterrence effect the drug prevention program had on the Navy work force in 1979/1980, 1985, and in 1995. This helps to establish a baseline for computing the impact of the program on drug use and to

assess the associated economic benefits. In addition, the costs of the "zero tolerance" policy are evaluated.

C. THE RESEARCH QUESTION

The questions that this research answers are:

- Did the implementation of the Navy's drug prevention policies achieve the desired results of minimizing drug use?
- What is the cost associated with the current "zero tolerance" policy?
- What are the overall costs and benefits of the drug testing and "zero tolerance" program?

D. DISCUSSION

"Zero tolerance" implies immediate military separation of sailors and officers who test positive for illicit drugs during random urinalysis testing. This thesis analyzes the deterrence effect of this "zero tolerance" program by comparing differences in illegal drug use between military and civilian populations, using data from the National Household Survey of Drug Abuse (NHSDA) and the Department of Defense's Worldwide Survey of Health Related Behaviors (DODWWS). The findings from this analysis of the deterrence effect establish a portion of the total benefits of the Navy drug prevention program.

By enforcing "zero tolerance" the Navy is stating that it will not tolerate any type of illegal drug use from its sailors and officers. This thesis evaluates the cost and

benefits of fully enforcing "zero tolerance." In particular, this thesis estimates the loss of human capital in the form of the replacement cost of those who are discharged in compliance with the Navy's "zero tolerance" policy. This thesis also attempts to evaluate the economic efficiency of the "zero tolerance" policy.

E. ORGANIZATION OF STUDY

Chapter II presents the history of the DoD's and Navy's drug prevention programs. Chapter III estimates the existence and possible magnitude of the deterrence effect associated with drug testing and the "zero tolerance" policy. Chapter IV calculates the replacement cost associated with the enforcement of the "zero tolerance" policy, which requires positive drug testers to be discharged from the U.S. Navy. Chapter V calculates the net benefits to the Navy of the drug prevention program and conducts a sensitivity analysis of the resulting net benefit estimates. Chapter VI summarizes the conclusions of the research and presents recommendations for further research.

II. BACKGROUND

A. DEPARTMENT OF DEFENSE DRUG TESTING POLICY

A DoD task force was assembled in 1967 to investigate possible illegal drug use in the military. [Ref. 2] By 1970, the findings and recommendations of the task force led to the creation of a formal policy, which ultimately became the DoD's new urinalysis drug-testing program. This policy emphasized the need to identify illegal drug users, rehabilitate these users, and return them to full duty status. [Ref. 2] This random urinalysis program was believed to be the champion in reducing the number of illegal drug use within the military. The DoD's drug testing program was not intended for disciplinary or corrective actions. Instead, the thought was that military drug users would be more likely to request help and rehabilitation in the absence of negative repercussions. Unfortunately, this was not a realistic expectation.

The Human Resources Research Organization (HumRRO) discovered two years later that there was a disparity between the number of military personnel surveyed who said anonymously that they were drug users as compared to the official number of military personnel who tested positive

in the DoD urinalysis testing program. [Ref. 3] Furthermore, HumRRO discovered that the DoD drug-testing program was not a disincentive to those service members interested in using illegal drugs. The results of their study prompted DoD to redirect their approach by using the results of the drug tests as a starting point for Uniform Code of Military Justice (UCMJ) procedures.

However, in July 1974, a Military Court of Appeals demanded that DoD stop urinalysis testing altogether if the specimen could be used in administrative or punitive actions. By this decision, any deterrence effect of the DoD program became null and void. After 1974 the drug urinalysis program, for the next six years, was used solely to indicate service members in need of rehabilitation. [Ref. 3] But in 1980, the Military Court of Appeals reversed its 1974 decision, permitting DoD to implement a drug urinalysis program to be both a deterrent and evidence-gathering device. [Ref. 4]

The Department of Defense published DoD Directive (DoDD) 1010.4 in August 1980. The intent of this directive was to establish the Department of Defense's drug and alcohol abuse policy and standards for all military service members, freeing DoD from the ill effects of illegal drug

use. [Ref. 5] Points relevant to this thesis, published in DoDD 1014.4, include:

- Assess the alcohol and drug abuse…influencing the Department of Defense
- Not induct persons in the military services who are alcohol or drug dependent
- Deter and detect alcohol and drug abuse within the Armed Forces
- Provide continuing education and training…to alleviate problems associated with alcohol and drug abuse
- Treat or counsel alcohol and drug abusers and rehabilitate the maximum feasible number of abusers [Ref. 5]

This directive also required each service secretary to establish and manage urinalysis drug testing programs for their respective branch of service. A follow-on directive, DODD 1010.1, was established in 1980 to assist the service secretaries in meeting this new requirement.

This new directive was used as a guideline by each branch of service in creating its specific drug-testing program. In particular, the intent of issuing DoDD 1010.1 was twofold:

- Preserve the health of DOD military service members by providing appropriate counseling, rehabilitation, and medical treatment to those identified as drug and alcohol abusers.
- Give commanders the leverage to evaluate the military fitness, good order and discipline, and security of their command, through the use of drug testing results. And when deemed

appropriate, take formal action to restore command integrity, based on their assessments. [Ref. 6]

DoDD 1010.1 listed guidelines and limitations to using drug urinalysis test results. This directive clearly stated that urinalysis results could be used, with specific restrictions, in punitive or separation proceedings. This directive ultimately became the foundation, which each branch of service used to create their respective random urinalysis testing program. Armed with this new DoD policy, the Chief of Naval Operations issued his own policy concerning illegal drug offenders.

B. DEPARTMENT OF THE NAVY DRUG TESTING POLICY

The Department of the Navy (DoN) established the Office of the Secretary of the Navy Instruction 5300.28A (SECNAVINST 5300.28A) in January 1984. [Ref. 7] The latest revision to this instruction is SECNAVINST 5300.28C, submitted in March 1999. [Ref. 8] For the use of this paper, the current instruction will be used as reference.

This Instruction, in accordance with DoD mandated policies, disseminates the regulations and policies regarding alcohol and drug abuse within DON. It requires the Chief of Naval Operations (CNO) and the Commandant of the Marine Corps (CMC) to establish and enforce alcohol and

drug abuse prevention programs for their respective branch of service. In addition, SECNAVINST 5300.28C identifies specific functional areas that both CNO and CMC must consider when implementing their respective alcohol and drug abuse prevention program: detection and deterrence; treatment and rehabilitation; preventive education and intervention training; and, enforcement and discipline. [Ref. 8]

In addressing the area of detection and deterrence of military drug abuse, SECNAVINST 5300.28C directs the use of random urinalysis to disclose drug use among military personnel, regardless of rank. The results of mandatory urinalysis, subject to certain restrictions, could be used to take appropriate disciplinary action; to establish the basis for separation proceedings; and to refer military members to a treatment or rehabilitation programs. [Ref. 8]

The Department of the Navy issued the Office of the Chief of Naval Operations Instruction 5350.4 (OPNAVINST 5350.4) in September 1980. As the subject line suggested, "Substance Abuse Prevention and Control," this instruction established the drug testing policy for all members of the United States Navy, which is one of zero tolerance to substance abuse in the Navy. "Zero tolerance recognizes

that drug and alcohol use is incompatible with the maintenance of high standards of performance, military discipline, and readiness and is destructive of Navy efforts to instill pride and promote professionalism." [Ref. 9] In other words, the Navy would simply not tolerate any type of legal drug abuse or illicit drug use by their military members.

Although this policy of zero tolerance implied strict rules to its members or "else" (facing the consequences), the policy itself was not enforced evenly among the ranks. There was a "double standard" within the policy where only officer and chief petty officers (E-7 to E-9) were automatically processed for administrative discharge after appropriate punitive proceedings were conducted. However, Junior enlisted (E-1 to E-6), however, would be screened and presented rehabilitation options if their drug abuse were determined treatable. Then, following appropriate punitive procedures and completed rehabilitation, a junior enlisted member could return to full active duty status if she/he was deemed worthy for retention. [Ref. 9] This "double standard" policy continued until 1990.

OPNAVINST 5350.4B removed this "double standard" in September 1990 when "zero tolerance" became applicable to

all ranks in the United States Navy. After 1990, when an individual was detected for using an illicit drug as a result of random drug urinalysis, that individual would be processed for separation subsequent to punitive proceedings. Nonetheless, discharge would not be the automatic result from processing this individual for separation. The individual could still remain in the Navy if deemed worthy for retention.

Amplified in OPNAVINST 5350.4B was the Navy's purpose for a drug-testing program. Four goals were now established for this policy:

- Create a process for assessing command readiness
- Deter drug use
- Use as a tool to monitor personnel in rehabilitation programs
- Institute a historical archive that can be used to track the demographic characteristics of Navy drug use [Ref. 10]

For the purpose of this thesis, the goal of deterring drug use is the main focus of research.

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III. DETERRENCE EFFECT

A. INTRODUCTION

As described in the previous chapter, the Navy's "zero tolerance" policy towards the nonmedical drug use among military members was implemented in 1981. The question that is addressed in this chapter of the thesis is by how much did the policy change the behavior of its work force? Did the policy deter military personnel from using drugs and, if so, to what extent?

A previous study by Mehay and Pacula [Ref. 11], on which our analysis is based, uses a civilian and military sample for both the pre- and post-implementation phase (before and after 1981) to compare the difference in drug use between military members and civilian workers before and after policy enactment. As a representative sample of the civilian population Mehay and Pacula used the National Household Survey on Drug Abuse (NHSDA), and for the military population the Department of Defense Worldwide Survey of Health Related Behaviors Among Military Personnel (DODWWS) was used. Because there was no single year prior to 1981 when both surveys were fielded, Mehay & Pacula merged the data from the 1979 NHSDA and the 1980 DODWWS.

Mehay and Pacula chose these two surveys because they immediately preceded the implementation of the military's program. These two merged surveys formed the "baseline" for comparison.

To estimate the deterrence effect caused by the policy, Mehay & Pacula used the 1995 NHSDA and DODWWS. Using multiple regression analysis, two dependent variables of interest were constructed, one that focuses on the illicit drug use in the past 12 months and one reflecting any drug use in the past month. Findings of their study clearly show a significant difference in drug use among military members compared to their civilian counterparts as well as a significant difference in drug use among military members before and after the implementation of the "zero tolerance" policy. This is termed the difference-in-difference estimate. [Ref. 11] One potential weakness of the Mehay-Pacula study, however, is the long time lag between the pre- and post-implementation years. There were 15 years between the two survey years (1979/80 - 1995). It is argued that:

> There may have been changes in the recruiting strategy employed by the military that would make the military population more or less like the civilian population over time in ways we have not measured. [Ref. 11]

Thus, differences in drug use may arise due to other changes over this long period rather than to implementation of the drug prevention program.

B. METHODOLOGY

1. General Outline

In order to estimate the deterrence effect of the policy, we use the 1979 NHSDA as a representative sample of a civilian population and the 1980 DODWWS as the respective sample of the military population prior to the implementation of the policy. The 1979/80 military-civilian data file serves as a baseline for comparison with later years' surveys. To offset the long time lag between the 1979/80 surveys and the 1995 surveys, we use surveys that were fielded in 1985 (both NHSDA and DODWWS), a year that immediately followed the implementation of the drug prevention policy. We compare the difference in the deterrence effect between 1979/80 and 1985 with that estimated between the 1979/80 and 1995, as done in Mehay & Pacula. This gives us the opportunity to not only estimate the direct effect of the policy (1979/80 - 1985) but also to estimate how the deterrence effect changed over time, if at all (1985 - 1995).

2. Analysis of the NHSDA Data

The NHSDA is a series of surveys that measure the prevalence and correlates of drug use in the U.S. civilian population. The surveys are designed to provide not only quarterly but also annual estimates. The NHSDA provides information on the illicit use of drugs, alcohol, tobacco, and nonmedical use of prescription drugs among U.S. households. NHSDA include questions on socioeconomic characteristics, such as age, martial status, gender, race, ethnicity, job status, and education. Furthermore, the surveys provide information on annual and past month usage for the following drug categories: cannabis, cocaine, hallucinogens, heroin, inhalants, alcohol, tobacco, and nonmedical use of prescription drugs, including psychotherapeutics and polysubstance use [Ref. 12].

The 1979 NHSDA is the sixth in a series of studies that began in 1971. It was sponsored by the National Institute on Drug Abuse (NIDA). The data were collected by the Response Analysis Corporation, Princeton, NJ. Research Triangle Institute, Research Triangle Park, NC, prepared the data and codebook for public release. The survey includes U.S. households ages 12 years and older. In the 1979 NHSDA respondents from rural areas were oversampled.

The nominative technique was used to elicit supplementary information about heroin use. All NHSDA are stratified multi-stage area probability samples. In the first stage, 103 districts or Primary Sample Units (PSU) were screened. 13,578 households were originally listed, 12,334 were found to be occupied and 8,718 were eligible for interview. To reduce reporting bias, the NHSDA uses self-administered questionnaires. 7,224 questionnaires were completed, yielding a response rate of 82.9%. [Ref. 12]

The 1985 NHSDA is the eighth survey, also including U.S. households aged 12 years and older. NIDA again sponsored the survey, which was conducted by Temple University Institute for Survey Research, Philadelphia, PA. Research Triangle Institute prepared the data and codebook for public release. In the 1985 NHSDA, blacks and Hispanics were oversampled in order to increase the reliability of estimates of drug use for these important groups. 112 PSU were originally listed, 25,968 households were screened of which 23,633 were selected for interview; 9,630 were eligible. 8,038 questionnaires were completed, yielding a response rate of 91% [Ref. 13 and Ref. 14].

The 1995 NHSDA is the fifteenth survey, including U.S. households of age 12 years and older. It originally

contained 115 PSU. 22,000 households were screened of which 17,747 interviews were completed, yielding a response rate of 80.6% [Ref. 15 and Ref. 16].

Some limitations of the NHSDA, however, should be noted here:

- All surveys are self-reported. Hence, the value of the data highly depends on the respondents' truthfulness and memory. On the other side, self-reporting reduces the possibility of reporting bias due to increased confidentiality.
- The surveys are all cross-sectional and not longitudinal. This means that the data provide a snapshot in a single year rather than measuring changes in the same group of individuals over time.
- The target population of the surveys is defined as the households of the contiguous U.S. (without Alaska and Hawaii). Two percent of the total population have been excluded:
    - Noninstitutional group quarters (such as military installations, college dormitories, group houses)
    - Institutional group quarters (such as prisons, nursing homes, treatment centers)
    - Persons with no permanent address (such as homeless and residents of single rooms in hotels)

3. Analysis of DODWWS Data

The DODWWS, which is sponsored by the Assistant Secretary of Defense (Health Affairs), provides comprehensive and detailed estimates of the prevalence of

alcohol use, nonmedical drug use, and tobacco use among active duty military. [Ref. 17]

DODWWS started in 1980 and its overall purpose is to determine the nature, causes and effects of illicit substance use and health behavior among military personnel. It also allows evaluation of the impact of current and future program policies targeting substance use and health decisions in this population [Ref. 11]. All DODWWS contain active duty personnel only, excluding recruits, service academy students, persons without leave, and persons who were in a state of change of station (PCS). To reduce reporting bias, the DODWWS use self-reported questionnaires rather than interviewer-administered data collection techniques. [Ref. 18]

The 1980 DODWWS is the first in a series of surveys and was conducted by Burt Associates. It contains 19,582 randomly selected military members (6,239 Army, 5,202 Navy, 2,861 Marine Corps, and 5,280 Air Force), yielding a response rate of 93% [Ref. 17].

The 1985 DODWWS is the third survey and was conducted by the Research Triangle Institute. 17,328 questionnaires were completed (5,879 Army, 4,335 Navy, 1,882 Marine Corps,

and 5,232 Air Force), yielding a response rate of 80% [Ref. 19 and Ref. 20].

The 1995 DODWWS was the sixth survey and again conducted by Research Triangle Institute. The final data set included 16,303 questionnaires (3,638 Army, 4,265 Navy, 3,960 Marine Corps, and 4,440 Air Force), yielding a response rate of 69.6% [Ref. 21 and Ref. 22]. Table 1 summarizes the sample sizes and response rates in the surveys used in this thesis.

Survey Year	Survey	Sample Size	Response Rate
1979	NHSDA	7,224	82.9%
1980	DODWWS (total)	19,582	93%
	Army	6,239	
	Navy	5,202	
	Marine Corps	2,861	
	Air Force	5,280	
1985	NHSDA	8,038	91%
	DODWWS (total)	17,328	80%
	Army	5,879	
	Navy	4,335	
	Marine Corps	1,882	
	Air Force	5,232	
1995	NHSDA	17,747	80.6%
	DODWWS (total)	16,303	69.6%
	Army	3,638	
	Navy	4,265	
	Marine Corps	3,960	
	Air Force	4,440	

Table 1. Sample Sizes and Response Rates NHSDA/DODWWS.

4. The Model

As in Mehay & Pacula, two indexes of respondents' illicit drug use are the focus of the analysis, one reflecting any illicit drug use in the past 12 months and one reflecting any use in the past month. Table 2 provides definitions of the analysis variables and means of the 1985 NHSDA and DODWWS. Appendices A and B list the respective mean values for the 1979 NHSDA/1980 DODWWS as well as the 1995 NHSDA/DODWWS. Note that the 1985 NHSDA is restricted to 17-49 year olds in order to align civilians with the age groups represented in the military sample. The military sample contains 16,933 observations; the civilian sample is restricted to 17-49 year olds and consists of 5,037 observations.

As can be seen from Table 1, both past-month (current) as well as past-year participation are significantly lower among military members, compared to the civilian sample, after the implementation of the "zero tolerance" policy. There are, however, a number of demographic differences that may be driving the usage differences, such as education level, race/ethnicity, age, and martial status, which suggests the necessity of multivariate regression analysis. In order to compare the findings of the three

different data points (i.e. 1979/80, 1985, and 1995), three models are constructed using available independent variables from the surveys. Standard demographic characteristics such as gender, age, martial status, race/ethnicity, and education level were available in all surveys.

Variables	Variable Definitions	Military Means	Civilian Means
Past-Month Drug Participation	=1 if respondent reports using any illicit drug in the past month	0.046 (0.209)	0.195 (0.397)
Past-Year Drug Participation	=1 if respondent reports using any illicit drug in the past year	0.071 (0.257)	0.302 (0.459)
Married	=1 if respondent is married	0.713 (0.453)	0.439 (0.496)
High School Diploma	=1 if respondent has high school diploma	0.307 (0.461)	0.365 (0.482)
Some College	=1 if respondent attended college but did not attain diploma	0.397 (0.489)	0.192 (0.394)
College Graduate	=1 if respondent has college degree	0.228 (0.420)	0.149 (0.356)
Age 17 - 20	=1 if respondent's age (in years) falls in category	0.064 (0.244)	0.191 (0.3932
Age 21 - 25	=1 if respondent's age (in years) falls in category	0.201 (0.401)	0.238 (0.426)
Age 26 - 34	=1 if respondent's age (in years) falls in category	0.344 (0.475)	0.430 (0.495)
Age 35 - 49	=1 if respondent's age (in years) falls in category	0.391 (0.488)	0.141 (0.348)
Black	=1 if respondent is Black , Negro or African American	0.160 (0.367)	0.244 (0.430)
Hispanic	=1 if respondent is Hispanic	0.064 (0.245)	0.260 (0.439)
Other Minority	=1 if respondent is other racial / ethnic minority	0.047 (0.211)	0.014 (0.120)
Female	=1 if respondent is female	0.077 (0.267)	0.565 (0.496)

Note: Restricted to ages 17 -49.
Military sample = 16,933; civilian sample = 5,037
Standard Deviation in parenthesis
The military sample includes officers and enlisted
The civilian sample includes all civilians

Table 2. Means from 1985 NHSDA and DODWWS.

Other characteristics known to be significantly correlated with illicit drug use, such as the presence of children, urbanity, current living arrangements, and religious orientation, were either unavailable or not collected in a consistent fashion [Ref. 11]. Hence, these variables are omitted.

For the DODWWS, no geographic identifiers were available. These identifiers would have allowed including geographic specific drug price information. Unless military installations are consistently placed in areas where drug prices are systematically different, however, the omission of price variables in demand equation is unlikely to bias the coefficient of the dependent variables. Even if geographic location information were available, it would be extremely difficult to implement a geographic price measurement due to the unique geographic mobility of military personnel (e.g. deployment) [Ref. 11].

Furthermore, officers from the military sample were omitted because of the very low drug use rates among

officers compared to enlisted service members [Ref. 21]. Officers, in their role as leaders, have more to lose by using drugs and are more indoctrinated into the military system and its culture. In addition, as will be described in the following chapter, actual positive drug test results indicate that about 99% of the drug usage occurs in the enlisted ranks, which justifies the focus on enlisted military personnel.

In order to align the civilian sample to its military counterpart (enlisted only), all civilians in professional, technical, and administrative occupations ("white-collar" occupations) were deleted from the sample. Only individuals in "blue-collar" occupations are included.

As mentioned above, the vast majority of service members are aged between 17 and 49 years. In order to align the civilian sample to the military population, four age groups were formed: (Age 1: 17-20, Age 2: 21-25, Age 3: 26-34, and Age 4: 35-49).

The two dependent variables of interest (past year and past month drug participation) are both mutually exclusive and collectively exhaustive [Ref. 23]. Since the dependent variables are binary, the following non-linear maximum

likelihood (logit) function for the regression analysis was used [Ref. 24]:

$$P(Drug12_i = 1) = \frac{1}{1+e^{-Z_i}}$$

$$P(Drug30_i = 1) = \frac{1}{1+e^{-Z_i}}$$

where: $Drug12_i$ = Probability that the i^{th} person will have used drugs within the last 12 months.

$Drug30_i$ = Probability that the i^{th} person will have used drugs within the last month.

The actual specification of the logit estimating model is as follows:

$$Z_i = \beta_0 + \beta_1 \text{ Military} + \beta_2 \text{ Female} + \beta_3 \text{ Married} + \beta_4 \text{ Black} + \beta_5 \text{ Hispanic} + \beta_6 \text{ Other Race} + \beta_7 \text{ Age1} + \beta_8 \text{ Age2} + \beta_9 \text{ Age3} + \beta_{10} \text{ High School Degree} + \beta_{11} \text{ Some College} + \beta_{12} \text{ College Graduate} + \varepsilon_i.$$

Appendix C shows an example of the SAS code for the merged data files for 1979/80.

C. FINDINGS

1. Combined Drug Participation Model

Tables 3 - 5 provide definitions and means of the analysis variables for the merged 1979 NHSDA and 1980 DODWWS data file, the merged 1985 NHSDA/DODWWS, and the

merged 1995 NHSDA/DODWWS file. Note the smaller sample sizes (compared to Table 1 and Appendixes A and B) due to sample restrictions. Since this analysis uses a binary dependent variable, marginal effects were calculated to allow an interpretation of the estimated coefficients' magnitude. Except for the dummy variables accounting for being in the military (evaluated as a change from 0 = civilian to 1 = military), all other variables were kept at their mean values. As a base case for estimating the marginal effects, a notional person with the following characteristics was chosen: white, civilian, single, male, no high school degree, age 35-49.

Variables	Variable Definitions	Military Means	Civilian Means
Past-Month Drug Participation	=1 if respondent reports using any illicit drug in the past month	0.197 (0.398)	0.235 (0.424)
Past-Year Drug Participation	=1 if respondent reports using any illicit drug in the past year	0.397 (0.489)	0.328 (0.470)
Married	=1 if respondent is married	0.492 (0.500)	0.459 (0.498)
High School Diploma	=1 if respondent has high school diploma	0.473 (0.499)	0.374 (0.484)
Some College	=1 if respondent attended college but did not attain diploma	0.343 (0.475)	0.236 (0.425)
College Graduate	=1 if respondent has college degree	0.032 (0.177)	0.077 (0.266)
Age 17 - 20	=1 if respondent's age (in years) falls in category	0.239 (0.426)	0.282 (0.450)
Age 21 - 25	=1 if respondent's age (in years) falls in category	0.381 (0.486)	0.283 (0.450)

Age 26 - 34	=1 if respondent's age (in years) falls in category	0.253 (0.435)	0.212 (0.408)
Age 35 - 49	=1 if respondent's age (in years) falls in category	0.127 (0.333)	0.223 (0.417)
Black	=1 if respondent is Black , Negro or African American	0.194 (0.395)	0.118 (0.322)
Hispanic	=1 if respondent is Hispanic	0.053 (0.224)	0.055 (0.228)
Other Minority	=1 if respondent is other racial / ethnic minority	0.032 (0.175)	0.030 (0.170)
Female	=1 if respondent is female	0.090 (0.286)	0.561 (0.496)

Note:
Restricted to ages 17 -49.
Military sample deletes officers
Civilian sample deletes professionals and college graduates
Military sample = 13,385; civilian sample = 3,881
Standard Deviation in parenthesis

Table 3. Means from 1979 NHSDA and 1980 DODWWS files, Restricted to Military Enlisted, Civilian Non-Professionals.

Variables	Variable Definitions	Military Means	Civilian Means
Past-Month Drug Participation	=1 if respondent reports using any illicit drug in the past month	0.057 (0.232)	0.200 (0.400)
Past-Year Drug Participation	=1 if respondent reports using any illicit drug in the past year	0.088 (0.283)	0.304 (0.460)
Married	=1 if respondent is married	0.684 (0.465)	0.416 (0.493)
High School Diploma	=1 if respondent has high school diploma	0.386 (0.487)	0.404 (0.491)
Some College	=1 if respondent attended college but did not attain diploma	0.474 (0.499)	0.192 (0.394)
College Graduate	=1 if respondent has college degree	0.055 (0.227)	0.068 (0.251)
Age 17 - 20	=1 if respondent's age (in years) falls in category	0.083 (0.275)	0.219 (0.413)
Age 21 - 25	=1 if respondent's age (in years) falls in category	0.235 (0.424)	0.253 (0.435)
Age 26 - 34	=1 if respondent's age (in years)	0.348	0.403

	falls in category	(0.476)	(0.490)
Age 35 - 49	=1 if respondent's age (in years) falls in category	0.334 (0.472)	0.126 (0.332)
Black	=1 if respondent is Black , Negro or African American	0.191 (0.393)	0.260 (0.439)
Hispanic	=1 if respondent is Hispanic	0.075 (0.263)	0.283 (0.451)
Other Minority	=1 if respondent is other racial / ethnic minority	0.052 (0.221)	0.014 (0.118)
Female	=1 if respondent is female	0.081 (0.272)	0.565 (0.496)

Note: Restricted to ages 17 -49.
Military sample deletes officers
Civilian sample deletes professionals and college graduates
Military sample = 13,151; civilian sample = 4,260
Standard Deviation in parenthesis

Table 4. Means from 1985 NHSDA and DODWWS Files, Restricted to Military Enlisted, Civilian Non-Professionals.

Variables	Variable Definitions	Military Means	Civilian Means
Past-Month Drug Participation	=1 if respondent reports using any illicit drug in the past month	0.026 (0.159)	0.105 (0.307)
Past-Year Drug Participation	=1 if respondent reports using any illicit drug in the past year	0.056 (0.230)	0.178 (0.383)
Married	=1 if respondent is married	0.623 (0.485)	0.396 (0.489)
High School Diploma	=1 if respondent has high school diploma	0.369 (0.483)	0.357 (0.479)
Some College	=1 if respondent attended college but did not attain diploma	0.527 (0.499)	0.223 (0.417)
College Graduate	=1 if respondent has college degree	0.073 (0.261)	0.086 (0.280)
Age 17 - 20	=1 if respondent's age (in years) falls in category	0.128 (0.335)	0.210 (0.407)
Age 21 - 25	=1 if respondent's age (in years) falls in category	0.273 (0.446)	0.205 (0.404)
Age 26 - 34	=1 if respondent's age (in years) falls in category	0.257 (0.437)	0.386 (0.487)
Age 35 - 49	=1 if respondent's age (in years)	0.341	0.200

	falls in category	(0.437)	(0.400)
Black	=1 if respondent is Black, Negro or African American	0.194 (0.395)	0.251 (0.433)
Hispanic	=1 if respondent is Hispanic	0.092 (0.290)	0.296 (0.457)
Other Minority	=1 if respondent is other racial / ethnic minority	0.071 (0.257)	0.027 (0.162)
Female	=1 if respondent is female	0.188 (0.391)	0.602 (0.490)

Note: Restricted to ages 17 -49.
Military sample deletes officers
Civilian sample deletes professionals and college graduates
Military sample = 12,487; civilian sample = 9,882
Standard Deviation in parenthesis

Table 5. Means from 1995 NHSDA and DODWWS Files, Restricted to Military Enlisted, Civilian Non-Professionals.

Table 6 shows estimates of the coefficient of the military dummy variable and the associated marginal effects for the 1979/80 NHSDA/DODWWS data. Column 1 shows estimates foe drug use models for the 17-49 age group, while Columns 2 and 3 of Table 6 provide estimates of drug use models for the 17-34 year olds and 17-25 year olds, respectively. Coefficient estimates of the full logit model of using any illicit drug in the past year and in the past month are recorded in Appendix D.

	Ages 17 - 49	Ages 17 -34	Ages 17 - 25
Past Year Participation	0.0909	0.1435	0.252
	(0.0495)[a]	(0.051)	(0.056)
	[1.998][b]	[3.482]	[6.281]
	{0.3164}[c]	{0.3974}	{0.4822}
Past Month Participation	-0.503	-0.4598	-0.3797
	(0.0541)	(0.055)	(0.060)
	[-7.304]	[-8.287]	[-8.076]
	{0.2155}	{0.2801}	{0.3497}
N	17,266	14,703	10,495

Notes: Based on merged 1979 NHSDA / 1980 DODWWS file;
NHSDA is restricted to ages 17-49.
Military sample deletes officers
Civilian sample deletes professionals
[a] Standard errors are reported in parentheses
[b] Marginal effects in brackets (in percentage points)
[c] Baseline predicted probability for civilians

Table 6. Logit Estimates of Military Coefficient in Drug Participation Models, 1979/1980 Data, Restricted Samples.

Table 6 shows that in 1979/80 the military population as a whole (17-49 year olds) was slightly more likely to have used drugs within the past year compared to civilians. A look at the past month participation probability, however, reveals that military members (17-49 years old) are about 7.3 percentage points less likely to have used drugs within the last month. Note that these difference estimates were calculated from survey data that was collected in 1979/1980, which was prior to the implementation of the military's drug prevention program.

Table 7 provides the results of the marginal effects for the data from the post-implementation year 1985 (NHSDA/DODWWS). Coefficient estimates from the full logistic specifications of the probability of using any illicit drug in the past year and in the past month are recorded in Appendix E. In 1985 the past year participation probability is 17.635 percentage points lower among 17-49 year olds in the military. The past month participation probability for the same age group is 11.08 percentage points lower for military personnel. Both drug measures suggest the military's drug prevention program generated a sizeable deterrence effect among military members by 1985. A comparison of drug use rates for the age groups 17-34 and 17-25 indicate that the difference in drug use between the military and civilian population between 1979/80 and 1985 for the younger age groups is even greater than for all age groups.

A comparison of the difference in the illicit drug use between civilians and military members and between the two survey years does not, however, provide any insight into whether the military's workforce changed its behavior toward drug use. The difference could be the result of a change in the behavior of drug use among the civilian

population. In order to determine whether a change in behavior among military personnel was due to the policy change, we apply the previously mentioned difference-in-difference estimate, in which the difference between the military and civilian population from one survey year is compared to that of another survey year. The findings show a difference-in-difference for past year participation between 1979/80 and 1985 of -19.633 percentage points and difference-in-difference of -3.776 percentage points for past month participation. This clearly shows a positive deterrence effect resulting from the implementation of the policy.

	Ages 17 - 49	Ages 17 -34	Ages 17 - 25
Past Year Participation	-1.4752 (0.0597)[a] [-17.635][b] {0.2457}[c]	-1.4119 (0.062) [-22.66] {0.3367}	-1.079 (0.079) [-20.90] {0.3840}
Past Month Participation	-1.3407 (0.0684) [-11.08] {0.1575}	-1.2911 (0.070) [-14.73] {0.2188}	-0.9103 (0.091) [-12.72] {0.2340}
N	17,316	12,399	6,145

Notes: Based on merged 1985 NHSDA and DODWWS file
NHSDA is restricted to ages 17-49.
Military sample deletes officers
Civilian sample deletes professionals
[a] Standard errors are reported in parentheses
[b] Marginal effects in brackets (in percentage points)
[c] Baseline predicted probability for civilians

Table 7. Logit Estimates of Military Coefficient in Drug Participation Models, 1985 Data, Restricted Samples.

We are also interested in whether the deterrence effect changed over time. We analyze this by comparing the military-civilian difference in 1979/80 with the military-civilian difference in the 1995 NHSDA/DODWWS data. Coefficient estimates from logistic specifications of the probability of using any illicit drug in the past year and in the past month are recorded in Appendix F. Table 8 shows the logit coefficients and marginal effects of the military dummy variables for the 1995 data file. As can be seen, both past year and past month participation probabilities for the military are lower than their civilian counterparts throughout all age groups.

	Ages 17 - 49	Ages 17 -34	Ages 17 - 25
Past Year Participation	-1.3447 (0.0574)[a] [-10.65][b] {0.1507}[c]	-1.2763 (0.061) [-13.177] {0.1951}	-1.129 (0.072) [-15.135] {0.2474}
Past Month Participation	-1.4968 (0.0767) [-6.52] {0.0858}	-1.4414 (0.081) [-8.251] {0.1112}	-1.3009 (0.096) [-9.561] {0.1371}
N	23,369	16,142	9,112

Notes: Based on merged 1995 NHSDA and DODWWS file
NHSDA is restricted to ages 17-49.
Military sample deletes officers
Civilian sample deletes professionals
[a] Standard errors are reported in parenthesis
[b] Marginal effects in brackets (in percentage points)
[c] Baseline predicted probability for civilians

Table 8. Logit Estimates of Military Coefficient in Drug Participation Models, 1995 Data, Restricted Samples.

A comparison of the 1995 findings to 1979/80 shows that the difference in past year participation between military and civilians decreased from +1.998 percentage points in 1979/80 to -10.65 percentage points in 1995, a difference-in-difference of -12.648 percentage points. On the other side, the military-civilian difference in current drug usage (past month participation) changed from -7.304 percentage points in 1979/80 to -6.52 percentage points in 1995, suggesting that there is no deterrence effect using this drug-use indicator. From the results, it seems as if the policy had only a small deterrence effect on the youngest age group (17-25-year-olds).

Second, a comparison of the 1995 probabilities to those of 1985 shows that after the military-civilian differences significantly dropped between 1979/80-1985, they all increased from 1985-1995 for all age groups. The complete difference-in-difference results are displayed in Table 9. This leads to the conclusion that the initial deterrence effect from the policy has not changed much over time. Because the baseline civilian predicted drug use probabilities are lower than in 1995 than in 1985, however, the percentage reduction in military drug use in 1995 is actually greater than in 1985. In 1985, for example, past-

month use was about 50% lower for 17-25 year olds, whereas in 1995, it was nearly 70% lower.

Difference - in - Difference (1979/80 - 1985)	Ages 17 - 49	Ages 17 -34	Ages 17 - 25
Past Year Participation	[-19.633]	[-26.142]	[-27.181]
Past Month Participation	[-3.776]	[-6.443]	[-4.656]

Difference - in - Difference (1979/80 - 1995)	Ages 17 - 49	Ages 17 -34	Ages 17 - 25
Past Year Participation	[-12.648]	[-16.659]	[-21.416]
Past Month Participation	[0.216]	[0.036]	[-1.484]

Difference - in - Difference (1985 - 1995)	Ages 17 - 49	Ages 17 -34	Ages 17 - 25
Past Year Participation	[6.985]	[9.483]	[5.765]
Past Month Participation	[4.56]	[6.479]	[3.159]

Note: Differences calculated as difference in military-civilian drug participation rates between two years.
Source: uses coefficients from Tables 6-8 in text.

Table 9. Difference-in-Difference Analysis Drug Participation Models, Restricted Samples.

2. Restricted Samples, Males only

As can be seen from Table 10 the representation of females is quite different in the civilian and military samples, ranging from 8.1% in the military (1985 DODWWS) to 60.2% in the civilian sector (1995 NHSDA). Although males and females are more or less equally distributed among the NHSDA (civilian sample), females are significantly under-represented in the DODWWS due to the prohibition on women serving in combat occupations.

Survey Year	DODWWS	NHSDA
1979/80	9%	56.10%
1985	8.10%	56.50%
1995	18.80%	60.20%

Table 10. Female Distribution of Respondents in NHSDA and DODWWS Surveys.

The models above assume that the estimated model coefficients are the same for males and females. It is quite possible, however, that the effect of being in the military has a different effect in terms of drug behavior for males and females. To test the assumption of equal coefficients, we apply a Likelihood Ratio Test (LRT). This test provides information on whether we may reject the

following null hypotheses, which imposes a restriction on the model of equal coefficients:

H_0: $\beta_1=\beta_2=\beta_3=\ldots=\beta_n=0$ (R)

H_1: $\beta_1\neq\beta_2\neq\beta_3\neq\ldots\neq\beta_n\neq0$ (UR_1)

H_2: $\beta_1\neq\beta_2\neq\beta_3\neq\ldots\neq\beta_n\neq0$ (UR_2)

where: R = Restricted Model, pooling males and females

UR_1 = Unrestricted Model, males only

UR_2 = Unrestricted Model, females only

The Likelihood Ratio Test can be written as follows: [Ref. 25]

$$\lambda = 2[L_{UR} - L_R] \sim \chi^2 ,$$

which can be re-written as:

$$\lambda = 2[(L_{female} + L_{male}) - L_R] \sim \chi^2$$

In order to reject the null hypothesis, the test statistic, λ must be greater than the critical Chi Square for the chosen level of significance. Table 11 summarizes the findings of the Likelihood Ratio Tests. The results support rejection of the null hypothesis in nearly all cases, thus rejecting the use of the restricted (pooled)

models. The only exception is for 17-to-25 year olds in 1985. Consequently, we re-estimated the drug use models for the male samples only.

	Past Year Participation			Past Month Participation		
Year	**λ**	**D.F.**	**Critical Chi-Square** [a]	**λ**	**D.F.**	**Critical Chi-Square** [a]
1979/80						
Ages 17-49	242.34	12	21.00	193.33	12	21.00
Ages 17-34	221.97	11	19.68	177.83	11	19.68
Ages 17-25	188.29	10	18.31	159.33	10	18.31
1985						
Ages 17-49	36.16	12	21.00	29.55	12	21.00
Ages 17-34	33.33	11	19.68	29.65	11	19.68
Ages 17-25	12.20	10	18.31	15.22	10	18.31
1995						
Ages 17-49	43.64	12	21.00	40.27	12	21.00
Ages 17-34	34.17	11	19.68	35.45	11	19.68
Ages 17-25	25.69	10	18.31	24.69	10	18.31

Notes: [a] 5% Level of Significance
D.F.: Degree of Freedom

Table 11. Results Likelihood Ratio Test.

Besides the use of males only, the earlier restrictions (exclusion of professionals as well as restricting the age to 17-49 year olds) were also applied to the civilian and military (exclusion of officers) surveys. Coefficient estimates of the military dummy variables from full logistic specifications of the probability of using any illicit drug in the past year and

in the past month are recorded in Appendix G. Table 12 summarizes the findings for the merged 1979/80 data file.

Overall, male military members are 0.215 percentage points less likely to have used drugs within the last year. Among the younger age groups (columns 2 and 3), however, military members are more likely to have used drugs within the last year. For past month drug participation, military males are about 10 percentage points less likely to use drugs.

	Ages 17 - 49	Ages 17 -34	Ages 17 - 25
Past Year Participation	-0.009	0.0615	0.197
	(0.0611)[a]	(0.063)	(0.070)
	[-0.215][b]	[1.516]	[4.887]
	{0.3493}	{0.4336}	{0.5199}
Past Month Participation	-0.63	-0.5712	-0.4681
	(0.0631)	(0.065)	(0.071)
	[-9.586]	[-10.874]	[-10.428]
	{0.2479}	{0.3165}	{0.3912}
N	13,723	11,730	8,284

Notes: Based on merged 1979 NHSDA / 1980 DODWWS file
[a] Standard errors are reported in parenthesis
[b] Marginal effects in brackets (in percentage points)
[c] Baseline predicted probability for civilians

Table 12. Logit Estimates of Military Coefficient in Drug Participation Models, 1979 and 1980 Data, Restricted Samples, Males Only.

The deterrence effect of the policy on the male military population toward the illicit use of nonmedical drugs in 1985 is displayed in Table 13. Coefficient

estimates from the full logistic specifications of the probability of using any illicit drug in the past year and in the past month are recorded in Appendix H. As can be seen, the drug use rate among male military members ages 17-49 within the last year is 16.22 points lower than civilians in 1985. The difference-in-difference is 16.01 percentage points between 1980 and 1985 (from -0.215 to -16.22 percentage points). The difference-in-difference for the younger age groups is between 20 and 24 percentage points. Using the past month participation rate shows that, for 17-49 year olds, the difference-in-difference is nearly zero.

	Ages 17 - 49	Ages 17 -34	Ages 17 - 25
Past Year Participation	-1.5145 (0.0681)[a] [-16.22][b] {0.2208}[c]	-1.4397 (0.071) [-24.298] {0.3611}	-1.044 (0.092) [-20.891] {0.3972}
Past Month Participation	-1.3768 (0.0771) [-9.516] {0.1322}	-1.3292 (0.080) [-16.264] {0.2396}	-0.9047 (0.104) [-13.256] {0.2532}
N	13,849	9,309	4,537

Notes: Based on merged 1985 NHSDA and DODWWS file
[a] Standard errors are reported in parenthesis
[b] Marginal effects in brackets (in percentage points)
[c] Baseline predicted probability for civilians

Table 13. Logit Estimates of Military Coefficient in Drug Participation Models, 1985 Data, Restricted Samples, Males Only.

The difference-in-difference is 5.39 percentage points and 2.82 percentage points for the 17-34 and 17-25 year olds, respectively.

To address the question of the change in the deterrence effect over time, the model was again applied to the 1995 NHSDA/DODWWS data file but using data on males only. Coefficient estimates from logistic specifications of the probability of using any illicit drug in the past year and in the past month are recorded in Appendix I. Table 14 summarizes the findings, and shows that both the past year and past month drug participation rates are significantly lower among male military members than their civilian counterparts, and that the military-civilian difference is lower in 1995 than it was in 1979/80.

	Ages 17 - 49	Ages 17 -34	Ages 17 - 25
Past Year Participation	-1.3867 (0.069)[a] [-12.095][b] {0.1695}[c]	-1.3051 (0.073) [-15.608] {0.2316}	-1.144 (0.089) [-16.931] {0.2791}
Past Month Participation	-1.5984 (0.090) [-7.963] {0.1021}	-1.5359 (0.095) [-10.552] {0.1391}	-1.3629 (0.114) [-11.362] {0.1602}
N	14,068	9,617	5,673

Notes: Based on merged 1995 NHSDA and DODWWS files
[a] Standard errors are reported in parenthesis
[b] Marginal effects in brackets (in percentage points)
[c] Baseline predicted probability for civilians

Table 14. Logit Estimates of Military Coefficient in Drug Participation Models, 1995 Data, Restricted Samples, Males Only.

Comparison with previous survey years, however, shows different results. In 1995 male military members were 12.095 percentage points less likely to use drugs within the last year (17-49 year olds), a difference-in-difference of -11.88 percentage points compared to 1980. A look at the current (past month) drug participation probability, however, shows again that the difference-in-difference is +1.96 percentage points. Even among the younger age groups, the difference-in-differences are nearly zero for past month drug use. Table 15 summarizes the difference-in-difference results.

Difference - in - Difference (1979/80 - 1985)	Ages 17 - 49	Ages 17 -34	Ages 17 - 25
Past Year Participation	[-16.01]	[-25.814]	[-25.778]
Past Month Participation	[0.47]	[-5.39]	[-2.828]

Difference - in - Difference (1979/80 - 1995)	Ages 17 - 49	Ages 17 -34	Ages 17 - 25
Past Year Participation	[-11.88]	[-17.124]	[-21.818]
Past Month Participation	[1.963]	[0.322]	[-0.934]

Difference - in - Difference (1985 - 1995)	Ages 17 - 49	Ages 17 -34	Ages 17 - 25
Past Year Participation	[4.125]	[8.69]	[3.96]
Past Month Participation	[1.553]	[5.712]	[1.894]

Note: Differences calculated as difference in military-civilian drug participation rates between two years.
Source: uses coefficients from Tables 12-14 in text.

Table 15. Difference-in-Difference Analysis Drug Participation Models, Restricted Samples, Males Only.

3. Results for Navy Personnel

As described in the previous chapter the implementation of the "zero tolerance" policy and its enforcement has varied within the military across the branches. The Army, for example, has the lowest drug-testing rate, while the Air Force has the strictest recruiting policy among the branches. Both factors (testing rate and selection) might influence the deterrence effect [Ref. 4]. Hence, we re-estimated our initial model by replacing the single military variable with dummy variables for each branch in order to decompose the deterrence effect with respect to the services. Using the new model, we first use the initial data files, including males and females (enlisted only, restricted to ages 17-49). Since this

thesis focuses on the Navy, in order to conserve space only the results for the Navy are displayed.

Table 16 shows the results for Navy personnel of the logit coefficients and the marginal effects for the merged 1979/80 data file. Coefficient estimates from logistic specifications of the probability of using any illicit drug in the past year and in the past month are recorded in Appendix J. The results indicate that prior to the program implementation, Navy members throughout all age groups were significantly more likely to have used drugs within the last year. With respect to past month drug participation, however, Navy personnel were about 5 percentage points less likely than civilians to use drugs.

	Ages 17 - 49 (Navy)	Ages 17 - 34 (Navy)	Ages 17 - 25 (Navy)
Past Year Participation	0.2074	0.261	0.3887
	(0.0568)[a]	(0.0581)	(0.0648)
	[4.653][b]	[6.379]	[9.651]
	{0.3174}[c]	{0.3955}	{0.4815}
Past Month Participation	-0.3419	-0.2995	-0.2166
	(0.0618)	(0.0627)	(0.0679)
	[-5.248]	[-5.615]	[-4.753]
	{0.2169)	{0.2793}	{0.3498}
N	17,266	14,703	10,495

Notes: Based on merged 1979 NHSDA / 1980 DODWWS file
[a] Standard errors are reported in parenthesis
[b] Marginal effects in brackets (in percentage points)
[c] Baseline predicted probability for civilians

Table 16. Logit Estimates of Military Coefficient in Drug Participation Models, 1979 and 1980 Data, Restricted Samples, by Branches.

The military-civilian differences for 1985 are shown in Table 17. Coefficient estimates from logistic specifications of the probability of using any illicit drug in the past year and in the past month are recorded in Appendix K. In 1985 Navy service members in all age groups were significantly less likely to use drugs within the last year as well as in the past month. For all ages, the past year drug usage rate for military members was 4.653 percentage points lower than in 1979/80. This yields a difference-in-difference of -22.763 percentage points.

	Ages 17 - 49 (Navy)	Ages 17 - 34 (Navy)	Ages 17 - 25 (Navy)
Past Year Participation	-1.5191	-1.434	-1.0989
	(0.0813)[a]	(0.0839)	(0.1053)
	[-18.11][b]	[-22.823]	[-21.287]
	{0.2487}[c]	{0.3358}	{0.3862}
Past Month Participation	-1.3336	-1.2503	-0.8551
	(0.0944)	(0.0972)	(0.1211)
	[-11.181]	[-14.394]	[-12.227]
	{0.1594}	{0.2178}	{0.2427}
N	17,316	12,399	6,145

Notes: Based on merged 1985 NHSDA and DODWWS file
[a] Standard errors are reported in parenthesis
[b] Marginal effects in brackets (in percentage points)
[c] Baseline predicted probability for civilians

Table 17. Logit Estimates of Military Coefficient in Drug Participation Models, 1985 Data, Restricted Samples, by Branches.

The drug use rate for past month participation for military personnel for the same age group was 11.181 percentage points lower in 1985. This yields a difference-in-difference of -5.933 percentage points. Between 1980 and 1985 the policy seems to have had the desired (positive) effect on the illicit use of drugs among Navy members.

Again, we applied the model to the merged 1995 NHSDA/DODWWS data file. Coefficient estimates from logistic specifications of the probability of using any illicit drug in the past year and in the past month are recorded in Appendix L. As shown in Table 18, estimates for the Navy indicate that its work force is less likely to have used drugs within the past year, ranging from a difference of -9.763 percentage points (ages 17-49) to as high as -12.884 percentage points (ages 17-25). Similarly, the overall (column 1) past month drug participation rate among Navy personnel is 6.02 percentage points lower than for their civilian counterparts.

Comparing the 1995 findings to 1979/80 show a difference-in-difference of -14.416 percentage points for 17-49 year olds in past year participation. The past month participation comparison for the same age group indicates a difference-in-difference of only -0.78 percentage points.

This suggests that the deterrence effect has not changed since 1985. The difference-in-difference results are summarized in Table 19.

	Ages 17 - 49 (Navy)	Ages 17 - 34 (Navy)	Ages 17 - 25 (Navy)
Past Year Participation	-1.1429 (0.0816)[a] [-9.763][b] {0.1515}[c]	-1.061 (0.0868) [-11.851] {0.1966}	-0.8864 (0.1018) [-12.884] {0.2491}
Past Month Participation	-1.2604 (0.1111) [-6.0238] {0.0863}	-1.1838 (0.1180) [-7.496] {0.1122}	-1.1052 (0.1426) [-8.766] {0.1380}
N	22,369	16,142	9,112

Notes: Based on merged 1995 NHSDA and DODWWS file
[a] Standard errors are reported in parenthesis
[b] Marginal effects in brackets (in percentage points)
[c] Baseline predicted probability for civilians

Table 18. Logit Estimates of Military Coefficient in Drug Participation Models, 1995 Data, Restricted Samples, by Branches.

Difference - in - Difference (1979/80 - 1985)
(in percentage points)

	Ages 17 - 49 (Navy)	Ages 17 - 34 (Navy)	Ages 17 - 25 (Navy)
Past Year Participation	[-22.763]	[-29.202]	[-30.938]
Past Month Participation	[-5.933]	[-8.779]	[-7.474]

Difference - in - Difference (1979/80 - 1995) (in percentage points)	Ages 17 - 49 (Navy)	Ages 17 - 34 (Navy)	Ages 17 - 25 (Navy)
Past Year Participation	[-14.416]	[-18.23]	[-22.535]
Past Month Participation	[-0.7758]	[-1.881]	[-4.013]

Difference - in - Difference (1985 - 1995) (in percentage points)	Ages 17 - 49 (Navy)	Ages 17 - 34 (Navy)	Ages 17 - 25 (Navy)
Past Year Participation	[8.347]	[10.972]	[8.403]
Past Month Participation	[5.1572]	[6.898]	[3.461]

Note: Differences calculated as difference in military-civilian drug participation rates between two years.
Source: uses coefficients from Tables 16-18 in text.

Table 19. Difference-in-Difference Analysis Drug Participation Models, Restricted Samples, by Branches.

4. Results for Male Navy Personnel

At this point, for the previously described reasons, we further restricted the samples to Navy males only. Coefficient estimates from logistic specifications of the probability of using any illicit drug in the past year and in the past month are recorded in Appendix M. Estimating

the model for the 1979/80 data file resulted in the findings displayed in Table 20. Columns 1 through 3 show that males in the Navy were significantly more likely to have participated in past year drug use. Especially males, aged 17-25 years, were about 8.2 percentage points more likely then their civilian counterparts. The past month participation findings, however, show that male Navy personnel throughout all age groups were roughly 7 percentage points less likely to have used drugs within the 30 days.

	Ages 17 - 49 (Navy)	Ages 17 - 34 (Navy)	Ages 17 - 25 (Navy)
Past Year Participation	0.1175	0.188	0.3357
	(0.0675)[a]	(0.0693)	(0.0775)
	[2.725][b]	[4.656]	[8.242]
	{0.3521}[c]	{0.4368}	{0.5214}
Past Month Participation	-0.4646	-0.4077	-0.3082
	(0.0703)	(0.0716)	(0.0782)
	[-7.712]	[-8.161]	[-7.066]
	{0.2513}	{0.3200}	{0.3933}
N	13,723	11,730	8,284

Notes: Based on merged 1979 NHSDA / 1980 DODWWS file
[a] Standard errors are reported in parenthesis
[b] Marginal effects in brackets (in percentage points)
[c] Baseline predicted probability for civilians

Table 20. Logit Estimates of Military Coefficient in Drug Participation Models, 1979 and 1980 Data, Restricted Samples, Navy Males Only.

Table 21 summarizes the impact of the drug prevention program in 1985. Coefficient estimates from logistic specifications of the probability of using any illicit drug in the past year and in the past month are recorded in Appendix N. The past year participation rate for the male Navy population (column 1) is 18.713 percentage points lower. Compared to 1979/80 this yields a difference-in-difference of -21.438 percentage points. 17-25 year old military members are 21.256 percentage points less like to have used drugs over the past year, resulting in a difference-in-difference of -29.498 percentage points. The past month participation findings show that male Navy personnel are significantly less likely to have used drugs within the last 30 days, ranging from -11.5 percentage points (column 1) to -16.1 percentage points (column 2).

	Ages 17 - 49 (Navy)	Ages 17 - 34 (Navy)	Ages 17 - 25 (Navy)
Past Year Participation	-1.5539	-1.445	-1.0446
	(0.0915)[a]	(0.0947)	(0.1207)
	[-18.713][b]	[-24.684]	[-21.256]
	{0.2544}[c]	{0.3628}	{0.4072}
Past Month Participation	-1.3649	-1.2716	-0.8369
	(0.1050)	(0.1084)	(0.1373)
	[-11.583]	[-16.104]	[-12.864]
	{0.1633}	{0.2440}	{0.2617}
N	13,849	9,309	4,537

Notes: Based on merged 1985 NHSDA and DODWWS file
[a] Standard errors are reported in parenthesis
[b] Marginal effects in brackets (in percentage points)
[c] Baseline predicted probability for civilians

Table 21. Logit Estimates of Military Coefficient in Drug Participation Models, 1985 Data, Restricted Samples, Navy Males Only.

If we compare the 1995 findings, shown in Table 22, to those of the pre-implementation period (1979/80), we find that on the one side that the difference-in-difference for past year drug use rate changed significantly, ranging from -13.89 percentage points (for 17-49 year olds) to -23.568 percentage points (for 17-25 year olds). On the other side, the past month participation rate only changed significantly for 17-25 year olds (roughly 4 percentage points). For ages 17-34 the difference-in-difference changed only slightly by 1.8 percentage points. For the whole male Navy sample, however, the military-civilian drug use difference for past month participation almost stayed at its level of 1979/80 (+0.283 percentage points). Coefficient estimates from logistic specifications of the probability of using any illicit drug in the past year and in the past month are recorded in Appendix O.

The complete difference-in-difference findings are displayed in Table 23. It is noteworthy that the deterrence

effect obtained for the full sample in Table 19 was altered very little by restricting the samples to Navy males only. Deterrence effect estimates for past year participation for 17-49 year olds (see Table 19) is -14.416 percentage points for the Navy (males and females) model (1979/80-1995), for male Navy personnel model the estimated deterrence effect is -13.89 percentage points (see Table 23), a difference of

	Ages 17 - 49 (Navy)	Ages 17 - 34 (Navy)	Ages 17 - 25 (Navy)
Past Year Participation	-1.2126 (0.0963)[a] [-11.165][b] {0.1685}[c]	-1.130 (0.1031) [-14.446] {0.2345}	-0.9782 (0.1242) [-15.326] {0.2819}
Past Month Participation	-1.3922 (0.1301) [-7.429] {0.1016}	-1.3239 (0.1397) [-9.918] {0.1411}	-1.2733 (0.1736) [-11.041] {0.1616}
N	14,068	9,617	5,673

Notes: Based on merged 1995 NHSDA and DODWWS file
[a] Standard errors are reported in parenthesis
[b] Marginal effects in brackets (in percentage points)
[c] Baseline predicted probability for civilians

Table 22. Logit Estimates of Military Coefficient in Drug Participation Models, 1995 Data, Restricted Samples, Navy Males Only.

only 0.526 percentage points. The deterrence effect estimates for past month participation for 17-49 year olds (see Table 19) is -0.7758 percentage points for the Navy (males and females) model (1979/80-1995), for the restricted to male Navy model the estimated deterrence

effect is 0.283 percentage points, a difference of only 1.0588 percentage points.

Difference - in - Difference (1979/80 - 1985) (in percentage points)	Ages 17 - 49 (Navy)	Ages 17 - 34 (Navy)	Ages 17 - 25 (Navy)
Past Year Participation	[-21.438]	[-29.34]	[-29.498]
Past Month Participation	[-3.871]	[-7.943]	[-5.798]

Difference - in - Difference (1979/80 - 1995) (in percentage points)	Ages 17 - 49 (Navy)	Ages 17 - 34 (Navy)	Ages 17 - 25 (Navy)
Past Year Participation	[-13.89]	[-19.102]	[-23.568]
Past Month Participation	[0.283]	[-1.757]	[-3.975]

Difference - in - Difference (1985 - 1995) (in percentage points)	Ages 17 - 49 (Navy)	Ages 17 - 34 (Navy)	Ages 17 - 25 (Navy)
Past Year Participation	[7.548]	[10.238]	[5.93]
Past Month Participation	[4.154]	[6.186]	[1.823]

Note: Differences calculated as difference in military-civilian drug participation rates between two years.

Source: uses coefficients from Tables 20-22 in text.

Table 23. Difference-in-Difference Analysis Drug Participation Models, Restricted Samples, Navy Males Only.

D. SUMMARY

This chapter has shown that the U.S. military's strict "zero tolerance" policy had a positive effect in terms of reducing the illicit use of nonmedical drugs among military members between 1979/80 and 1985. All findings clearly indicate that both past year as well as past month drug participation decreased between the pre- and post-implementation periods. Furthermore, all findings show that the policy had the greatest impact on the youngest age groups of the military, especially for 17-25 year olds. Comparison of the findings from 1985 to the 1995 uniformly show, however, that the initial deterrence effect, caused by the policy and the possible uncertainty among military members about its consequences/impacts, significantly decreased over time. This is true whether past year or past month participation measures are used.

In addition, if we compare the pre-implementation findings (1979/80) to those of 1995, we find two main results in all models. First, all findings show a positive deterrence effect of the policy on past year participation, ranging from as low as -11.88 percentage points (military combined, males only, ages 17-49) to as high as -23.568 percentage points (Navy, males only, ages 17-25). Second,

the findings for past month participation show a positive deterrence effect for 17-25 year olds ranging from -1 percentage point (military combined, males only) to as high as -4 percentage points (Navy, males only). For the entire Navy sample, all models show almost no change in past month participation. The findings range from an increase of 0.216 percentage points (restricted sample, males and females, ages 17-49) to 1.963 percentage points (males only, ages 17-49). Only the combined sample (males and females) broken down by services show an insignificant decrease of -0.78 percentage points, which indicates that the deterrence effect has remained relatively constant over time.

Since this thesis focuses on the deterrence effect for the Navy, we use the findings of the Navy-only models. For the calculations in the following chapters, however, we use the results from the most recent deterrence effect (1979/80 compared to 1995). Table 24 summarizes the findings from Table 19 and Table 23, focusing on the deterrence effect for 1995.

Model: By Branches, Males and Females Difference - in - Difference (1979/80 - 1995) (in percentage points)	Ages 17 - 49 (Navy)	Ages 17 - 34 (Navy)	Ages 17 - 25 (Navy)
Past Year Participation	[-14.416]	[-18.23]	[-22.535]
Past Month Participation	[-0.7758]	[-1.881]	[-4.013]

Model: By Branches, Males only Difference - in - Difference (1979/80 - 1995) (in percentage points)	Ages 17 - 49 (Navy)	Ages 17 - 34 (Navy)	Ages 17 - 25 (Navy)
Past Year Participation	[-13.89]	[-19.102]	[-23.568]
Past Month Participation	[0.283]	[-1.757]	[-3.975]

Table 24. Summary Deterrence Effect 1979/80-1995.

The size of the deterrence effect for those two periods vary depending on which age groups and which drug use measure is used. It should be noted, however, that the findings for the past year participation are possibly biased because the DODWWS questionnaires do not take into account that, due to the long time lag the question covers, respondents may or may not have used drugs prior to their entry into the military. A respondent who answers the past

year participation question in October, may have joined the military in June. Hence, drug use for five months as a civilian would be attributed to the "zero tolerance" policy although the respondent has been in the military for only five months. The past month participation variable avoids this possible bias by not including recruits in the sample of questionnaires.

The adjusted military-civilian differential in drug use in the three different periods is repeated in Table 25.

	Military-Civilian Differences		
	Year		
	1979/80* (Navy)	**1985*** (Navy)	**1995*** (Navy)
Past Year Participation	+4.653	-18.11	-9.763
Pst Month Participation	-5.248	-11.181	-6.0238

Notes: In percentage points
* From Tables 16-18

Table 25. Summary Deterrence Effect Ages 17-49, for Navy.

Note that drug use rates in 1979/80, the pre-policy year, were similar in the two sectors, whereas use rates in the military were much lower in the two post-policy years. For the following chapter we treat the military-civilian

difference for 1995 (-9.76 percentage points) as the "true" deterrence effect for past year participation, since the drug use rate in 1979/80 was significantly higher in the military than for the civilians. For past month participation, however, the previously calculated deterrence effect of −0.78 percentage points (see Table 19 and Table 24) are used.

IV. THE COST OF A ZERO TOLERANCE POLICY: ESTIMATING THE REPLACEMENT COST OF DISCHARGED PERSONNEL

A. BACKGROUND

The previous chapter of this thesis has estimated a positive deterrence effect resulting from the implementation and enforcement of the Navy's "zero tolerance" policy towards the nonmedical abuse of drugs among military personnel. Based on the main aim of the policy and the public perception towards drug abuse, the policy appears to have been successful. There was a drastic decrease of drug usage within the military after implementation of the zero tolerance policy in the early 1980's. Despite the zero tolerance policy, however, the goal of zero usage has not been accomplished. However small it might be, there is still an unknown proportion of service members who use drugs, and only some percentage of those are detected via urinalysis.

Even though both the deterrence and detection effects of the Navy's drug prevention policies are measurable and generate positive economic benefits, an important cost must also be evaluated - the replacement costs of those discharged from the Navy after testing positive. The goal

of this chapter is to quantify the replacement cost of those discharged from the Navy in FY99.

Unfortunately, based on the military's unique structure in which lateral entry is almost impossible (see Figure 1), a discharged person cannot be replaced in the same way a spare part for broken equipment is replaced. Depending on the rating and the years of service (YOS), a detailer cannot replace the discharged person by hiring a similarly skilled and trained person in the civilian labor force. Replacing a person can only occur from the bottom upwards, i.e. by "hiring" a new military enlistee (see Figure 1). Thus, replacement costs for military personnel who are discharged tend to be higher than for civilian personnel discharged from private firms.

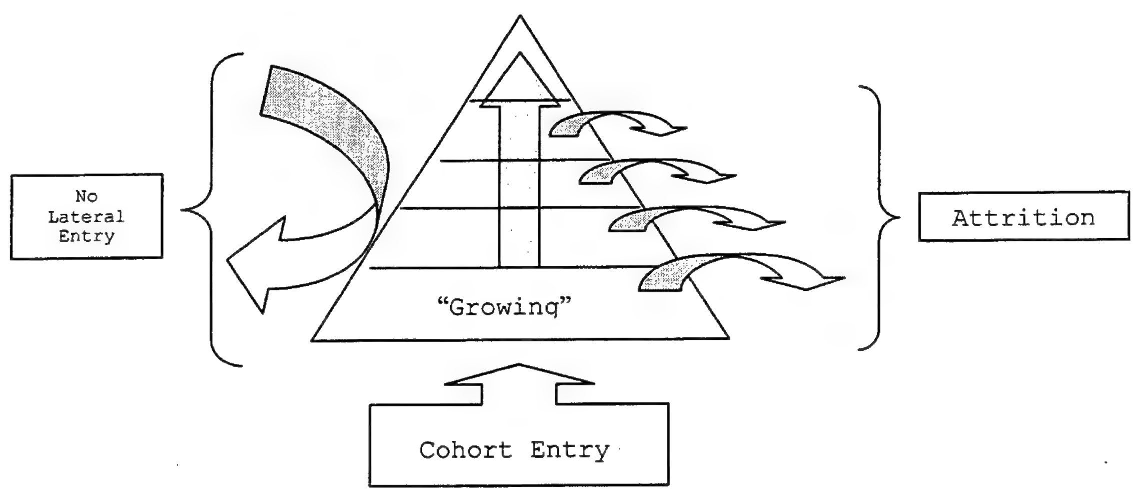


Figure 1. Hierarchical Pyramid Structure of the Military.

Figure 2 shows, based on FY99 continuation rates for all Navy enlisted personnel, the cohort survival rate (left vertical axis) and the resulting number of accessions needed (right vertical axis) to replace one discharged military member by years of service (YOS). As can be seen, the greater the YOS of the discharged person the more new entrants must be hired to ensure that at a certain point in time there will be a skilled and trained replacement for the discharged person. This clearly indicates that discharging a drug user generates fairly high replacement costs. According to Figure 2, for example, a military member who is discharged at 10 YOS requires about seven (6.89) new accessions to ensure that one service member will survive to YOS 10. The lower the continuation rate in a given rating, the higher the number of new accessions required to replace one discharged service member.

B. METHODOLOGY

1. Positive Test Takers Data Set

As pointed out in a previous study by Borack and Mehay [Ref. 26], information on the paygrade, length of service (or years of service, YOS), and rating of discharged individuals are required to estimate replacement costs. The analysis requires information on individuals discharged by the Navy. A data set provided by the Defense Manpower Data

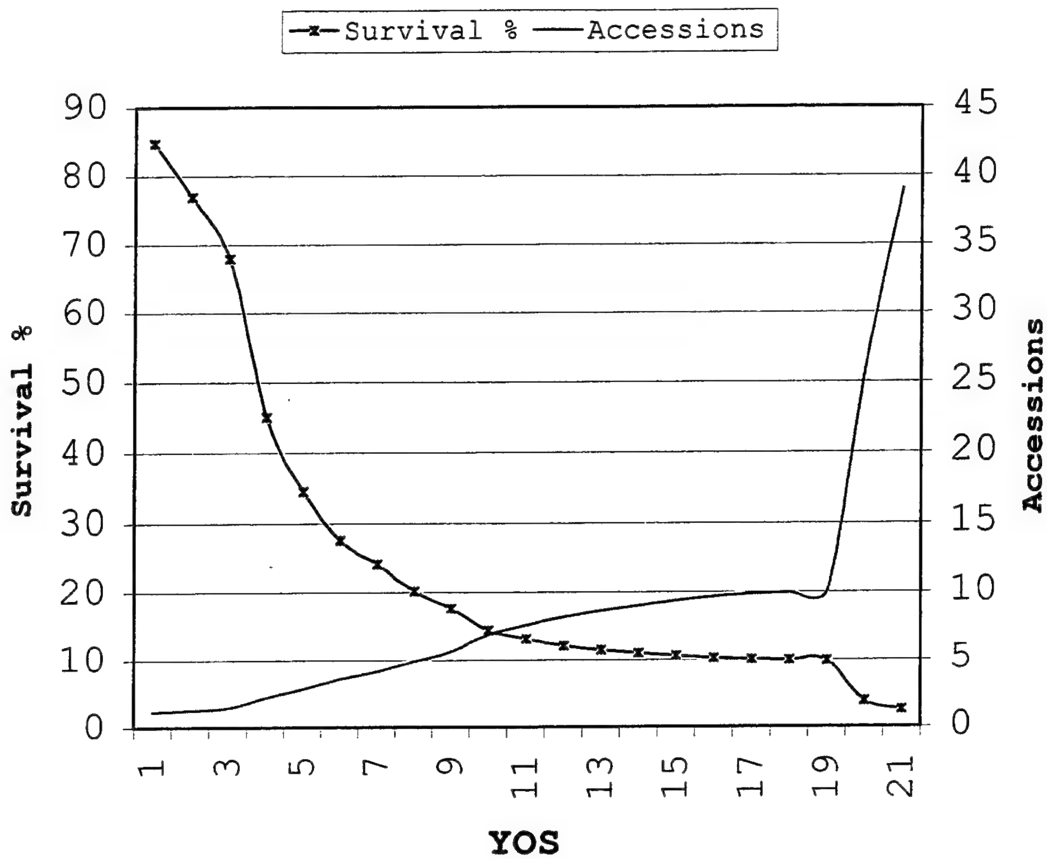


Figure 2. Cohort Survival Rate and Number of Accessions needed to Replace Leavers (All Navy Enlisted).

Center (DMDC)[Ref. 27], contains the needed information on the 5,446 Navy personnel who were detected via urinalysis and discharged due to nonmedical drug use during FY99. Table 18 summarizes the socioeconomic characteristics of the discharged personnel. Appendix K provides the layout of the entire DMDC data set.

As Table 26 shows, approximately 60% of the discharged personnel are white, 24% are black/African American, and

about 10% are Hispanic. Of the discharged Navy personnel, 94% were males. Roughly 46% of all discharged personnel were between 17 and 20 years old and about 40% were between 21 and 25 years old. A close look at the distribution of drug abuse with respect to grade (Paygroup) shows that over 99% of all detected and discharged personnel were in paygrades E1 through E9, only 0.55% in the officer ranks. This justifies the methodology applied in the analysis of the deterrence effect in the previous chapter of deleting officers (and professionals in the civilian samples) in order to focus on the main group of potential drug users.

In order to conserve space, the distribution of positive testers with respect to YOS was also grouped by enlistment-terms (e.g. first term with YOS 1-4). The data reveal that the highest incidence of nonmedical drug abuse occurred among first termers, those with one to four YOS (86.6%). Note that discharging those abusers rather than rehabilitating them exacerbates the current problem facing the Navy of attrition of first term personnel. As can be seen, drug use among military members decreases significantly after the first term of enlistment.

Variable	Characteristic	Frequency	Percentage
Race/Ethnicity	Unknown	13	0.24
	White	3,246	59.61
	Black	1,330	24.43
	Hispanic	560	10.28
	American Indian	149	2.73
	Asian/Pacific	132	2.42
	Other	16	0.29
Gender	Male	5,115	93.95
	Female	331	6.05
Age	Age 17-20	2,487	45.66
	Age 21-25	2,168	39.81
	Age 26-34	591	10.85
	Age 35-49	197	3.63
	Age 50-60	3	0.06
Paygroup	E1 - E9	5,416	99.45
	O1 - O6	30	0.55
Years of Service (YOS)	YOS 1-4	4,716	86.6
	YOS 5-8	372	6.83
	YOS 9-12	128	2.35
	YOS 13-16	118	2.17
	YOS 17-20	88	1.62
	YOS 21-24	18	0.33
	YOS 25-28	6	0.11

Notes: Source: DMDC

N = 5,446

Table 26. Socioeconomic Characteristics of Navy Personnel Discharged in FY99 for Testing Positive for Drug Use.

For these same reasons (described in Chapter III) and in order to be consistent, we deleted data on all officers from the data set. Table 27 summarizes the socioeconomic characteristics of the remaining positive drug testers.

2. Replacement Cost Per Person

The study by Borack and Mehay attempted to approximate average replacement cost by using drug usage rates (by

Variable	Characteristic	Frequency	Percentage
Race/Ethnicity	Unknown	12	0.22
	White	3,219	59.44
	Black	1,329	24.54
	Hispanic	560	10.34
	American Indian	149	2.75
	Asian/Pacific	132	2.44
	Other	15	0.28
Gender	Male	5,095	94.07
	Female	321	5.93
Age	Age 17-20	2,487	45.92
	Age 21-25	2,167	40.01
	Age 26-34	581	10.73
	Age 35-49	180	3.32
	Age 50-60	1	0.02
Years of Service (YOS)	YOS 1-4	4,710	86.96
	YOS 5-8	365	6.74
	YOS 9-12	126	2.33
	YOS 13-16	113	2.09
	YOS 17-20	84	1.55
	YOS 21-24	15	0.28
	YOS 25-28	3	0.06

Notes: Source: DMDC

N = 5,416

Table 27. Socioeconomic Characteristics of Navy Personnel Discharged in FY99 for Testing Positive for Drug Use (Enlisted Only).

paygrade) as reported in Bray et al. [Ref. 28]. Borack-Mehay applied the median years of service for each paygrade to the Yeoman (YN) rating to derive the average replacement cost. In contrast, this thesis attempts to determine the actual cost of replacing each individual discharged from the Navy in FY99. Unfortunately, replacement cost tables, which the Navy used to maintain, were not available at the

time of this thesis research. This thesis had to calculate all replacement costs for discharged personnel. This approach is diagrammed in Figure 3, and discussed in the next section.

Figure 3 shows that two different methodologies are used to derive the cost figures. The first ("one-for-one") methodology assumes that discharged individuals can be replaced on a one-for-one basis. The second ("agriculture cost") approach recognizes the Navy's internal labor market and the necessity to hire several new entrants to ensure that one person survives and is available to replace those who separate with several years of service. Both methodologies are described in greater detail below.

3. Cost of Manpower Estimating Tool (COMET)

COMET, which is available online, is a PC-based (Windows95®) tool that provides estimates of Operating and Support (O&S) cost for active duty, reserves, and civilian components of Navy manpower. Analysts can use this information to make decisions about various manpower-to-manpower or manpower-to-hardware tradeoffs. This thesis focuses on active duty Navy personnel only, thus "Active Duty Tutorial" in COMET was used.

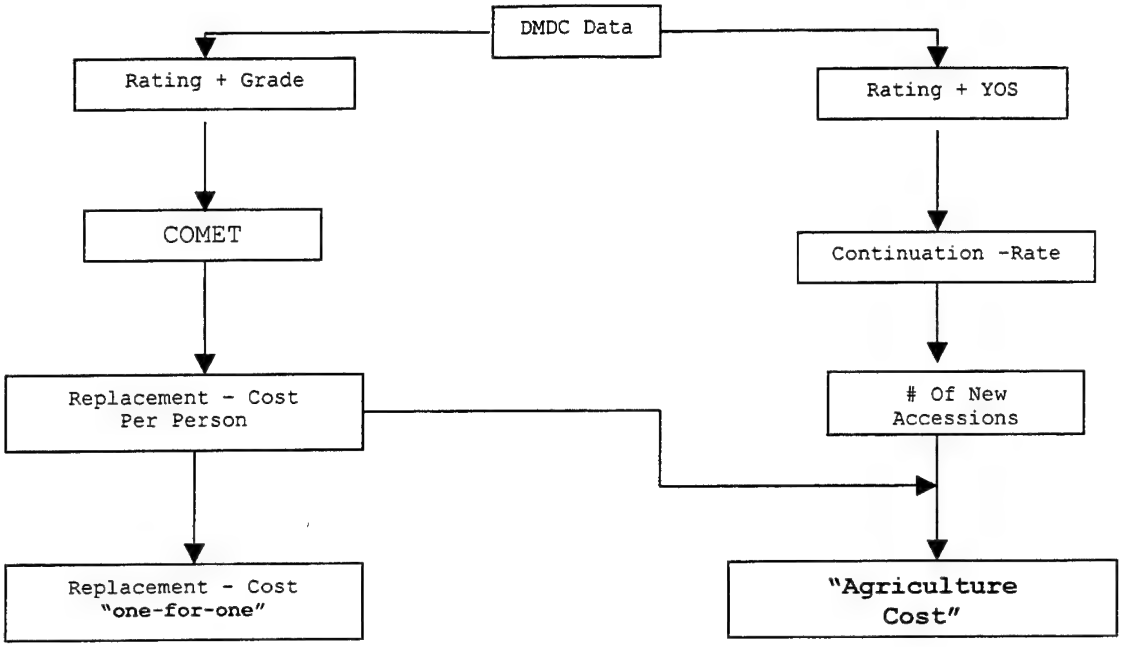


Figure 3. Methodology for Replacement Cost Calculations.

At the heart of COMET's active duty manpower cost methodology is the identification of "variable indirect" costs, associated with changes in end strength (covering FYs 1980-1996). This concept includes other "documented" manpower "support" costs to recruit, train, locate and support the "sea duty" oriented (ships, squadrons) force, as that force varied from FYs 80-89 (buildup) through FYs 90-96 (draw down).

The continuing development of the COMET model is a result of a five-year research project (started in 1996), jointly undertaken by the Naval Center for Cost Analysis (NCCA) and Dr. Henry L. Eskew (then with the Center for Naval Analyses CNA). Eskew's trilogy of "Cost Of A Sailor" (COAS) studies form the basis for his change in "end

strength"-driven variable indirect manpower cost methodology.

Eskew applied statistical time-series regression to establish a linear relationship between the change in the number of support personnel billets and the change in the number of operational billets in the fleet. His findings outlined a method to capture variable indirect personnel costs associated with operational billets in the fleet. [Ref. 29] The COMET model was created in order to provide a software tool that would enable the user to more accurately estimate the total, marginal, and average costs of filling the Navy's active billets. COMET includes econometric and operational research simulation models, which can be used to explore the effects of various personnel policies on manpower costs. COMET, a relatively new costing tool to the Navy, deals exclusively with the marginal costs of personnel, which is especially useful for studies concerning hardware versus manpower tradeoffs. [Ref. 29]

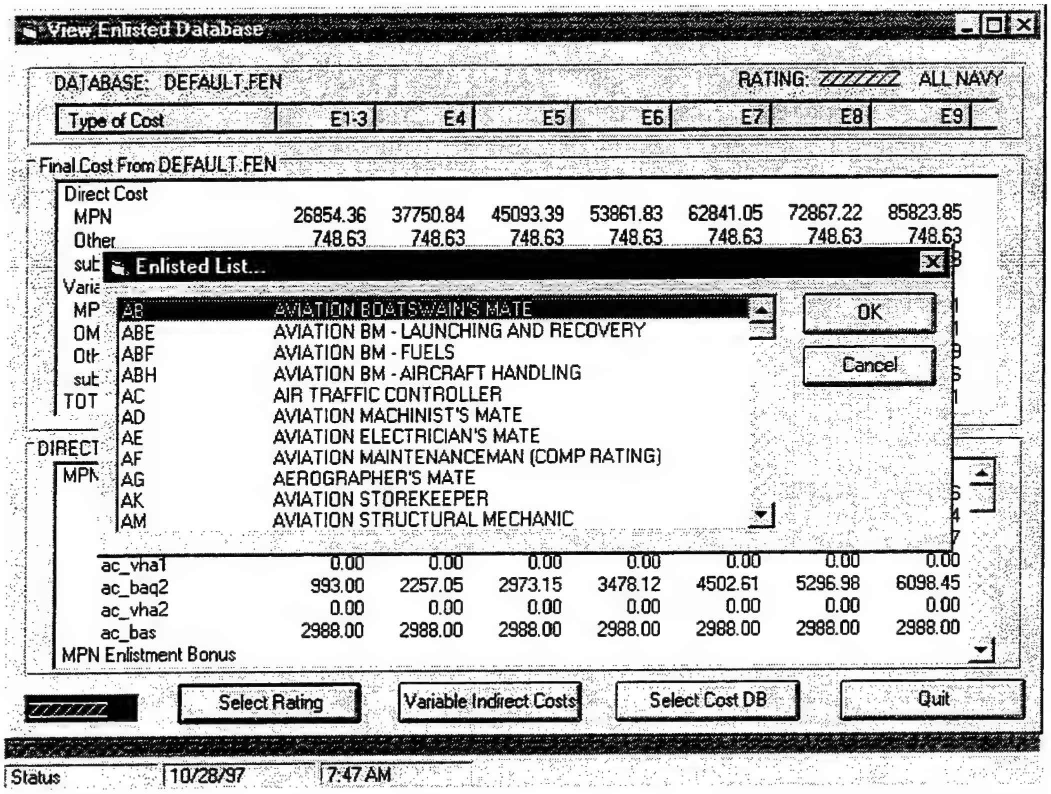
COMET provides cost calculations by paygrade, officer community and enlisted specialty, and includes items that are funded by Military Personnel, Navy (MPN) accounts (such as basic pay, allowances, retirement accrual, FICA contributions, and PCS costs). Furthermore, COMET provides

variable indirect personnel costs, funded through a mix of MPN and Operation and Maintenance, and Navy (OMN), such as training and base operational support. Finally, it also includes other non-Navy costs, such as TRICARE (funded by the Assistant Secretary of Defense (Health Affairs) and Montgomery GI Bill (funded by the Veterans Administration) [Ref. 30]. Support for the COMET model is provided by the prime contractor, SAG Corporation (http://www.sagcorp.com), based in Falls Church, Virginia.

4. Ratings

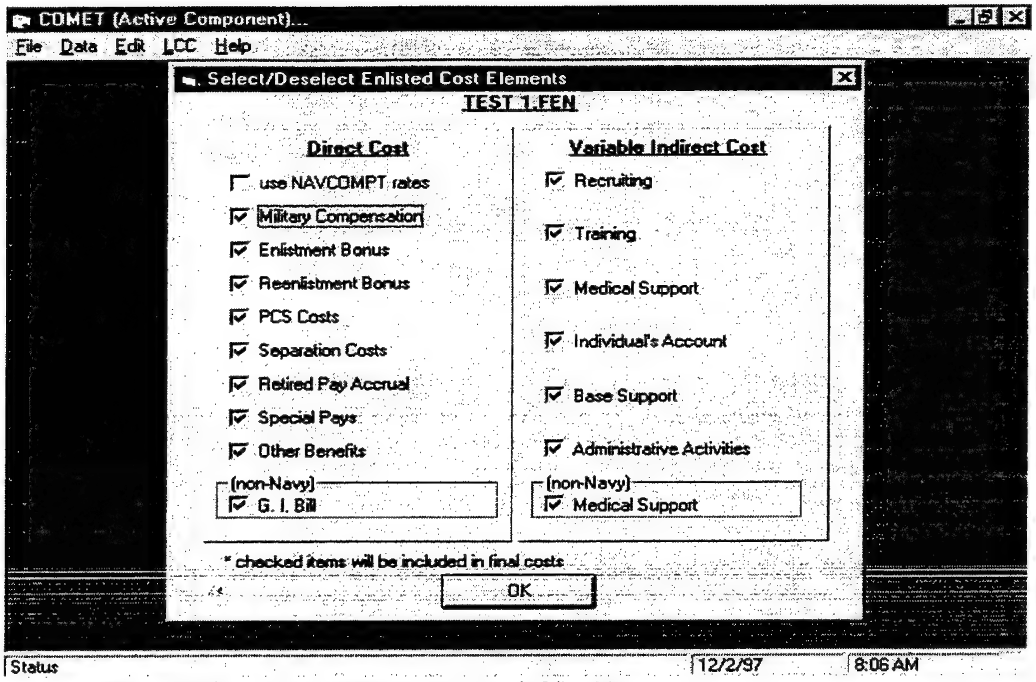
The database of the "Active Component" in COMET is divided by enlisted and officer components. Once the user chooses a database, COMET allows the user to change the FY dollar value for which the costs are calculated. The data set used for this thesis is based on FY99. The advantage in using the FY99 DMDC data set in combination with COMET is that the DMDC data set contains the specific rating for each discharged individual. The rating of each particular individual can be chosen within COMET from a menu list, which is shown in Figure 4. COMET calculates the manpower costs for each Navy rating. There were 88 different enlisted ratings extracted from the data file.

Figure 5 shows one of the menus accessible in COMET, (shown here for enlisted cost calculations), from which the user can choose the type of costs to be included in the calculations.



Source: COMET "Active Duty Component Tutorial" NCCA (http://www.ncca.navy.mil/comet/download.htm)

Figure 4. COMET Rating Menu.



Source: COMET "Active Duty Component Tutorial" NCCA (http://www.ncca.navy.mil/comet/download.htm)

Figure 5. COMET Cost Element Menu.

According to BUPERS [Ref. 31], the Navy calculates the replacement cost of a person by allocating the training costs of student time and a proportion of some instructor time and materials. Following BUPERS' methodology, only training and recruiting costs (variable indirect costs) were included in the cost calculations in this thesis. One limitation of COMET, however, is that the calculated training and recruiting costs vary by rating but are constant for all paygrades. For example, the training and recruiting costs for an E1 are the same as to that for an E9. This is a potential weakness of COMET because it can be assumed that an E9 receives additional training (e.g.

refresher and/or update) during his/her career. This tends to bias the estimated replacement costs downward. For each rating of discharged personnel, the replacement cost for the individual (consisting of MPN and OMN training and recruiting costs) was calculated.

For some ratings COMET did not provide specific costs. Table 28 lists the ratings that are not included in COMET.

Rating	Description
AN	Airman
DN	Dental man
FN	Fireman
HN	Hospital corpsman
SN	Seaman
AR	Airman - Recruit
DR	Dental man - Recruit
FR	Fireman - Recruit
HR	Hospital corpsman - Recruit
SR	Seaman - Recruit
AA	Airman - Apprentice
DA	Dental man - Apprentice
FA	Fireman - Apprentice
HA	Hospital corpsman - Apprentice
SA	Seaman - Apprentice

Table 28. Adjusted Ratings.

However, the model provides average costs for an "All Navy" category (enlisted or officer). Thus, the "All Navy" cost figure was applied to the following ratings: Hospital Corpsman (HN), Airman (AN), Seaman (SN), Fireman (FN), and Dentalman (DN). For recruits and apprentices, cost calculations were based on the training level of the individual, based on whether the individual completed bootcamp or A-School. This information was provided by BUPERS (N793M) for each of these ratings. [Ref. 32] Fortunately, the FY99 data set contained enough information in order to identify whether a discharged person completed "bootcamp-only" or "A-School".

5. Continuation Rates/Number of New Accessions Needed to Replace Dischargees

Based on the previously described structure of the military (Figure 1), the assumption that a discharged person can easily be replaced in every rating at any point of time may be unrealistic. As shown in Figure 1 and Figure 2, the Navy can only replace somebody from the "grown" inventory, which over time, decreases. The magnitude of the "inventory decay" depends on specific ratings. The later (with respect to YOS) a person is discharged, the more severe the replacement problem becomes. Continuation rates, cohort survival rates, and the resulting number of required

new accessions vary significantly over the spectrum of ratings. In this thesis a "one-for-one" replacement was applied in order to obtain a lower-bound cost estimate. The second methodology of computing the replacement cost per person is based on the number of new accessions that are necessary in order to ensure that one person "survives" to a given YOS and provides an upper-bound cost estimate. The question that has to be answered is how many people in a given rating, after accounting for the discharged person's YOS, must be accessed in order to ensure that one person in that particular rating will be available at the YOS of the discharged person. This is also called "agriculture" costs, which is a primary component of replacement cost.

In order to apply this second methodology to the discharges in FY99, actual continuation rates for each of the represented ratings, broken down by YOS, are necessary. These rates were calculated and provided for this thesis by a Navy contractor, DynMeridian. [Ref. 33]

Using the above mentioned continuation rates, the cohort survival rates for each rating, broken down by YOS, can be calculated as in equation (1):

$$s_{jt} = \prod_{i=1}^{t} p_{ji} \qquad (1)$$

where: p_{jt} = continuation rate for YOS t in rating j.

S_{jt} = survival rate for YOS t in rating j.

t = 1,…, 30 YOS.

Using these survival rates for the particular rating, the necessary number of accessions to replace one person, given his/her YOS, is computed as in equation (2):

$$a_{jt} = \frac{1}{s_{jt}} \qquad \text{or} \qquad a_{jt} = \frac{1}{\prod_{i=1}^{t} p_{jt}} \qquad (2)$$

where: a_{jt} = number of necessary accessions at the entry point for rating j with "goal-YOS" t.

p_{jt} = continuation rate for YOS t in rating j.

S_{jt} = survival rate for YOS t in rating j.

t = 1,…, 30 YOS.

Table 29 shows an example of actual continuation rates for one rating, Boatswain's Mate, Fuel (ABF), for YOS 1-24. Applying equation (1) yields the cohort survival rate in column 2. Inverting the cohort survival rate, as shown in equation (2), yields the required accessions in column 3. Figure 6 graphs the findings from Table 29.

ABF			
BOATSWAIN MATE (FUELS)			
YOS	Continuation Rate	Cohort Survival Rate	Required Accessions
1	0.8553	0.8553	1.17
2	0.9135	0.7813	1.28
3	0.8288	0.6475	1.54
4	0.4262	0.2760	3.62
5	0.6602	0.1822	5.49
6	0.9385	0.1710	5.85
7	0.8621	0.1474	6.78
8	0.7791	0.1148	8.71
9	0.8776	0.1008	9.92
10	0.7846	0.0791	12.65
11	0.9275	0.0733	13.63
12	0.9592	0.0704	14.21
13	0.9592	0.0675	14.82
14	0.9474	0.0639	15.64
15	1.0000	0.0639	15.64
16	0.9434	0.0603	16.58
17	0.9714	0.0586	17.07
18	1.0000	0.0586	17.07
19	0.9545	0.0559	17.88
20	0.4167	0.0233	42.92
21	0.7273	0.0169	59.01
22	0.6000	0.0102	98.35
23	0.4000	0.0041	245.87
24	0.3333	0.0014	737.62

Source: DynMeridian Corporation

Table 29. Example Cohort Survival Rate.

Table 30 shows for example that 12.6 accessions are required to ensure that one ABF is available at YOS 10. This is due to the fact that nearly 60% of the cohort leaves the Navy at the end of YOS 4, and nearly 80% have separated by YOS 10. These low continuation rates (high separation rates) yield a low survival rate to YOS 10 (0.0791). Stated differently, of every 12 new recruits

brought into this rating, only 1 is still serving in the Navy 10 years later.

As can be seen in both Figure 6 and Table 30 some adjustments had to be made in order to keep the number of required accessions within reasonable bounds. First, as can be seen, since the U.S. military system is based on an average upper enlistment period of 20 YOS, at which service members are eligible for retirement benefits, the vast majority of members leave the military at 20 years. Thus, at YOS 20, the cohort survival rate generally drops to a level at which the resulting number of required new accessions "explodes" almost exponentially. These numbers are excessive because the Navy personnel system is geared to 20-year careers. Even though some personnel stay beyond 20 years, there is no explicit policy of replacing people who leave after YOS 20.

In Table 30 for example (for a Boatswain's Mate, Fuel), the number of required accessions increases from 17.88 at the end of YOS 19 to almost 43 accessions at the end of YOS 20, and grows to 737.63 accessions at the end of YOS 24. Since the military does keep a proportion of service members with more than 20 YOS this indicates that there is some demand for people with these service lengths.

Therefore, we could not simply ignore the accessions demand for personnel who leave after 20 YOS.

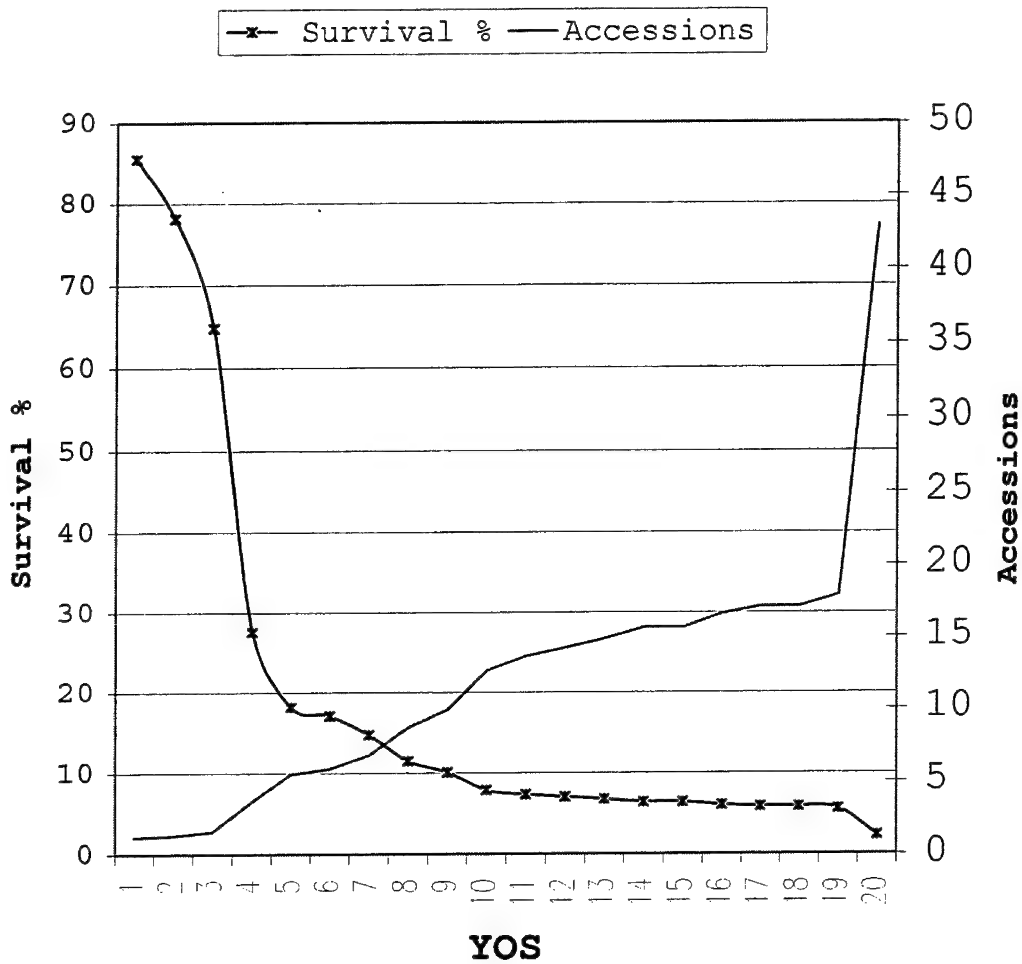


Figure 6. Adjusted Rating (Boatswain's Mate, Fuel (ABF)).

After examining all necessary accessions for individuals in the FY99 data, the decision was made to assign a maximum of 30 accessions per rating. Since the military enlistment system is based on 20 YOS, individuals with more than 20 YOS and 30 necessary accessions, were

assigned an average cohort survival rate from the "All Navy" estimate for 20 YOS. This solved the problem in all cases of more than 20 YOS and more than 30 accessions. Applying this adjustment to the calculation resulted in a drop of accessions, depending on the YOS, to below 25. Ratings with fewer than 20 YOS but more than 30 accessions, mainly in the "low-skill" ratings with more than two YOS, were also adjusted by assigning an average cohort survival rate ("All Navy") for the corresponding YOS.

C. REPLACEMENT COST CALCULATIONS

Based on the ratings represented among the 5,416 enlisted Navy personnel discharged in FY99, the training and recruiting costs per person were calculated using COMET for each individual. For ratings not represented in COMET (Airman, Dentalman, Fireman, Hospital Corpsman, and Seaman), the "All Navy" average replacement cost were used. The replacement costs for recruits and apprentices were based on the individual's training level -- bootcamp or A-School -- and based on cost data from BUPERS. Table 22 lists the replacement costs for the enlisted ratings represented in COMET. The costs range from a low of $7,151 (e.g. Navy Counselor) to a high of $46,067 for an Electrician's Mate (Submarine, Nuclear).

Rating	Title	Replacement Cost ($) (FY 1999)
AB	Aviation Boatswain's Mate	$ 12,015.87
ABE	Aviation BM - Launching and Recovery	$ 13,287.17
ABF	Aviation BM - Fuels	$ 13,425.83
ABH	Aviation BM - Aircraft Handling	$ 16,880.59
AC	Air Traffic Controller	$ 15,972.43
AD	Aviation Machinist's Mate	$ 16,880.59
AE	Aviation Electrician's Mate	$ 23,467.57
AF	Aviation Maintenanceman (Comp Rating)	$ 12,015.87
AG	Aerographer's Mate	$ 15,055.13
AK	Aviation Storekeeper	$ 15,053.98
AM	Aviation Structural Mechanic	$ 7,151.16
AME	Aviation Struct Mech - Safety Equip	$ 16,880.59
AMH	Aviation Struct Mech - Hydr Mech	$ 16,880.59
AMS	Aviation Struct Mech - Structures	$ 16,880.59
AO	Aviation Ordnanceman	$ 16,880.59
AS	Aviation Support Equipment Technician	$ 16,880.59
AT	Aviation Electronics Technician	$ 18,409.35
AV	Aviation Avionics Technician (Comp Rating)	$ 12,015.87
AW	Aviation ASW Operator	$ 16,203.29
AZ	Aviation Maintenance Administrationman	$ 14,826.00
BM	Boatswain's Mate	$ 16,880.59
BT	Boilerman	N.A.
BU	Builder	$ 9,685.23
CE	Construction Electrician	$ 11,532.05
CM	Construction Mechanic	$ 10,473.89
CTA	Cryptologic Technician (Administrative)	$ 15,349.93
CTI	Cryptologic Technician (Interpretative)	$ 12,015.88
CTM	Cryptologic Technician (Maintenance)	$ 22,569.89
CTO	Cryptologic Technician (Communications)	$ 15,928.48
CTR	Cryptologic Technician (Collection)	$ 13,527.73
CTT	Cryptologic Technician (Technical)	$ 17,404.68
CU	Constructionman (Comp Rating)	$ 7,151.16
DC	Damage Control	$ 13,632.49
DIV	Diver (EMC)	$ 7,151.16
DK	Disbursing Clerk	$ 14,836.39
DM	Illustrator Draftsman	$ 12,015.87

Rating	Title	Replacement Cost ($) (FY 1999)
DP	Data Processing Technician	$ 12,015.87
DS	Data Systems Technician	$ 12,015.87
DT	Dental Technician	$ 12,015.87
EA	Engineering Aid	$ 9,977.44
EM	Electrician's Mate	$ 19,523.88
EMNUCSS	Electrician's Mate Sub Nuc (EMC)	$ 46,066.99
EMNUCSW	Electrician's Mate Surf Nuc (EMC)	$ 40,430.25
EMSW	Electrician's Mate Surf (EMC)	$ 41,204.18
EN	Engineman	$ 19,878.89
ENAUX	Engineman, Auxiliaries (EMC)	$ 22,428.86
ENMN	Engineman, Main Propulsion (EMC)	$ 22,428.86
EO	Equipment Operator	$ 9,615.32
EOD	Explosive Ordnance Disposal	$ 7,151.16
EQ	Equipmentman (Comp Rating)	$ 7,151.16
ET	Electronics Technician	$ 18,409.35
ETNUCSS	Electronics Technician, Sub Nuc (EMC)	$ 44,210.76
ETNUCSW	Electronics Technician, Surf Nuc (EMC)	$ 38,574.05
ETSS	Electronics Technician, Sub (EMC)	$ 23,621.93
ETSW	Electronics Technician, Surf (EMC)	$ 7,151.17
EW	Electronic Warfare Technician	$ 18,399.23
FC	Fire Controlman	$ 25,972.85
FT	Fire Control Technician (Comp Rating)	$ 18,757.21
FTG	Fire Control Tech - Gun	N.A.
GM	Gunner's Mate	$ 12,091.52
GMG	Gunner's Mate - Guns	$ 23,274.06
GMM	Gunner's Mate - Missile	$ 13,544.63
GS	Gas Turbine Systems Technician	$ 12,015.88
GSE	Gas Turbine - Electrical	$ 29,475.34
GSM	Gas Turbine - Mechanical	$ 26,103.98
HM	Hospital Corpsman	$ 12,015.88
HMDIV	Medical Deep Sea Dive Tech (EMC)	$ 7,151.16
HMNUC	Nuclear Medicine Tech (EMC)	$ 7,151.16
HMSEAL	Special Operations Tech (EMC)	$ 7,151.16
HMSUB	Independent Duty Corpsman, Sub (EMC)	$ 13,790.07
HMSURF	Independent Duty Corpsman, Surf (EMC)	$ 7,151.16
HT	Hull Maintenance Technician	$ 19,807.38
IC	Interior Comm Electrician	$ 20,408.46
ICSS	Interior Comm Electrician, Sub (EMC)	$ 10,149.83
IM	Instrumentman	$ 21,963.75
IS	Intelligence Specialist	$ 17,845.79
JO	Journalist	$ 16,880.59
LI	Lithographer	$ 16,880.59
LN	Legalman	$ 16,880.59
MA	Master-At-Arms	$ 9,353.59
ML	Molder	$ 12,015.88

Rating	Title	Replacement Cost ($) (FY 1999)
MM	Machinist's Mate	$ 13,691.86
MMNUCSS	Machinist's Mate, Sub Nuc (EMC)	$ 25,881.41
MMNUCSW	Machinist's Mate, Surf Nuc (EMC)	$ 20,244.67
MMSS	Machinist's Mate, Sub (EMC)	$ 10,020.20
MN	Mineman	$ 22,960.74
MR	Machinery Repairman	$ 15,308.83
MS	Mess Management Specialist	$ 13,202.37
MSSS	Mess Management Specialist, Sub (EMC)	$ 10,214.26
MT	Missile Technician	$ 19,187.36
MU	Musician	$ 16,871.33
NC	Navy Counselor	$ 7,151.16
OM	Opticalman	$ 29,707.65
OS	Operations Specialist	$ 23,257.16
OT	Ocean Systems Technician (Comp Rating)	$ 12,015.87
OTA	Ocean Systems Technician, Anal	$ 13,527.73
OTM	Ocean Systems Technician, Maint	$ 13,544.63
PC	Postal Clerk	$ 13,005.85
PH	Photographer's Mate	$ 16,880.59
PM	Patternmaker	$ 12,015.87
PN	Personnelman	$ 14,586.38
PR	Aircrew Survival Equipmentman	$ 16,880.59
QM	Quartermaster	$ 14,524.32
QMSS	Quartermaster, Sub (EMC)	$ 9,027.78
RM	Radioman	$ 16,104.60
RMSS	Radioman, Sub (EMC)	$ 11,604.60
RP	Religious Program	$ 13,793.00
SEAL	Seal, Special Warfare (EMC)	$ 7,151.16
SH	Ship's Serviceman	$ 14,168.38
SK	Storekeeper	$ 14,950.15
SKSS	Storekeeper, Sub (EMC)	$ 9,027.78
SM	Signalman	$ 14,263.95
STG	Sonar Technician - Surface	$ 15,434.16
STS	Sonar Technician - Submarine	$ 18,674.72
SW	Steelworker	$ 9,466.54
TM	Torpedoman's Mate	$ 14,471.24
TMSS	Torpedoman's Mate, Sub (EMC)	$ 11,483.13
UT	Utilitiesman	$ 10,167.00
WT	Weapons Control Technician	$ 12,015.88

Rating	Title	Replacement Cost ($) (FY 1999)
YN	Yeoman	$ 14,500.78
YNSS	Yeoman, Sub (EMC)	$ 9,027.78

Source: COMET "Active Duty Component Tutorial" NCCA (http://www.ncca.navy.mil/comet/download.htm)

N.A. = not available in COMET.

Table 30. Replacement Costs Enlisted (FY99 dollars).

Table 31 shows the average "All Navy" replacement costs for the enlisted occupations that were not specifically represented in COMET. The average for these non-rated occupations was $17,344.

Rating	Title	Cost ($) (FY 1999)
HN	Hospitalman	$ 17,344.71
AN	Airman	$ 17,344.71
SN	Seaman	$ 17,344.71
FN	Fireman	$ 17,344.71
DN	Dentalman	$ 17,344.71

Source: COMET "Active Duty Component Tutorial" NCCA (http://www.ncca.navy.mil/comet/download.htm)

Table 31. Replacement Costs Enlisted (Average).

Table 32 summarizes the replacement costs for recruits and apprentices. As can be seen, the replacement costs differ significantly between a recruit/apprentice who is discharged from bootcamp ($6,858) and one who is detected and discharged from A-School ($21,950).

		Cost ($) (FY 1999)	
Rating	Title	Bootcamp only	Bootcamp + A-School
AR	Airman - Recruit	$ 6,858.00	$ 21,950.00
DR	Dentalman - Recruit	$ 6,858.00	$ 21,950.00
FR	Fireman - Recruit	$ 6,858.00	$ 21,950.00
HR	Hospitalman - Recruit	$ 6,858.00	$ 21,950.00
SR	Seaman - Recruit	$ 6,858.00	$ 21,950.00

		Cost ($) (FY 1999)	
Rating	Title	Bootcamp only	Bootcamp + A-School
AA	Airman - Apprentice	$ 6,858.00	$ 21,950.00
DA	Dentalman - Apprentice	$ 6,858.00	$ 21,950.00
FA	Fireman - Apprentice	$ 6,858.00	$ 21,950.00
HA	Hospitalman - Apprentice	$ 6,858.00	$ 21,950.00
SA	Seaman - Apprentice	$ 6,858.00	$ 21,950.00

Source: BUPERS N793M

Table 32. Replacement Costs Recruits/Apprentice.

In order to calculate replacement costs, two assumptions/methodologies were pursued. Using a "one-for-one" basis, the total replacement cost for the discharged Navy personnel in FY99 is the sum of the replacement cost per person (consisting of training and recruiting costs from Table 28 to Table 32) of the 5,416 Navy personnel. The "agriculture cost" basis accounts for rating-specific continuation rates. Hence the replacement cost under the "agriculture cost methodology" is the sum of the rating-specific replacement cost per person times the number of required accessions.

Under the assumption that discharged personnel are replaced on a "one-for-one" basis, the total cost of the 5,416 Navy personnel (enlisted) discharged in FY99 is $71.1 million. The total replacement costs under the "agriculture" cost methodology is $177.1 million.

D. SUMMARY

This chapter described the consequences of the "zero tolerance" policy with respect to the cost of replacing discharged personnel. Using continuation rates and cohort survival rates allows us to calculate the number of accessions necessary to replace individuals discharged at various YOS. Applying this "agriculture" cost methodology, which represents an upper-bound cost estimate, the cost of discharges in FY99 was $177.1 million. A one-for-one replacement methodology provided a lower-bound cost estimate of $71.1 million.

It should be noted here, however, that both cost calculations, especially the costs calculated under the "agriculture" cost assumption, are downward biased for several reasons. First, given the current robust labor market conditions, the military in general must compete with civilian firms. In order to meet recruiting and retention goals, the Navy has to create incentives in the

form of enlistment or reenlistment bonuses. These bonuses (although provided by COMET), were omitted, since the amount and the bonus offer depend on the time of the year and the fluctuations in recruiting success. Omitting bonuses biases the calculated costs downward.

Secondly, setting the cut-off point for necessary accessions for those with YOS greater than 20 also biases cost estimates downward.

Thirdly, for some ratings, specific training and recruiting costs were not available. We applied the "All Navy" average replacement cost in these cases, which may generate some replacement error.

These potential biases, taken together, ensure that the cost estimates are conservative. This is acceptable since it biases the cost-benefit calculations in favor of the drug policy. If the zero tolerance policy is unable to meet the positive net benefit test under these assumptions, we will be more confident in the conclusion that the program is not efficient.

IV. COST-BENEFIT ANALYSIS AND SENSITIVITY ANALYSIS

A. BACKGROUND

In the previous chapters, this thesis demonstrated the existence of a positive deterrence effect from the implementation and enforcement of the Navy's zero tolerance policy. The thesis also demonstrated that the magnitude of the deterrence effect varies significantly, depending on which drug measure is used, and which comparison groups are selected. The cost of the zero tolerance policy was calculated using COMET. This chapter applies the estimates from Chapters II and III in a cost-benefit analysis, which accounts for the costs of the zero tolerance policy and the benefits to the Navy.

Previous studies have calculated the effects of drug and/or alcohol use on employee productivity to measure the benefits of implementing and enforcing a drug reduction/prevention policy. The associated benefits of such a policy is in terms of costs avoided by the organization, rather than in terms of economic profit. Measuring benefits as costs avoided is a common practice, especially when programs produce mostly internal improvements to an organization. The complication of this

approach, however, lies in the difficulty of observing the magnitude of the actual degradation in employee productivity due to drug use, and thus measuring the improvements in productivity associated with programs that reduce drug use.

Extensive research on the effects of drug and/or alcohol use confirms that heavy users of drugs or alcohol are significantly more prone to absenteeism and tardiness, to make more on the job errors, to cause more accidents, and be to file claims for disability or health insurance for medical treatment not related to drugs. [Ref. 34 and Ref. 35] In the absence of a classical, controlled experiment, however, it is difficult to determine the exact differences in these drug-related outcomes. Little information exists on the productivity differences between employees who do and do not use drugs. When information does exist, "it is difficult to link the contribution of the observed difference (such as in errors made on the job or absenteeism) to differences in productivity and even more difficult to assess the monetary value of that difference to the organization." [Ref. 36]

In organizations such as the Navy that produce an output that is intangible (such as "national defense" or

"readiness"), it is even more difficult to measure differences in productivity. As a result, an indirect approach is adopted in this thesis. Basic labor economics hypothesizes that holding job characteristics and workers' human capital constant, workers are paid on the basis of their current productivity in the organization (marginal productivity) [Ref. 37]. Our indirect approach relies on the assumption that workers are paid on this basis. Observable pay differences between drug users and non-users, holding all other characteristics constant, should provide a measure of the actual productivity differences due to drug use.

B. METHODOLOGY AND FINDINGS FOR BENEFITS

1. Degradation Factor

To implement the indirect approach, we adopt prior estimates of the effects of drug use on male earnings. Information/studies of the effects of drug use on female wages were not available. As mentioned in the previous chapter, the DMDC data set contains 94% males and 6% females. Hence, the focus is primarily on males. Table 33 summarizes the estimated effects of alcohol and drug use on earnings derived from previous econometric studies. [Ref. 38 and Ref. 39]

Borack and Mehay [Ref. 36] used the indirect approach to measure the benefits of drug prevention programs. This thesis modifies their approach in several ways. Since this thesis focuses on the effects of drug use only, degradation factors associated with alcohol use might not represent the "true" effects of drug use. Hence, the studies by Mullahy and Sindelar (1993 and 1994), on the effects of alcohol use on male wages, which were relied on by Borack and Mehay, are not used in this thesis. The study by French et al. [Ref. 40] on the effects of receiving treatment on the difference between pre- and post- treatment earnings have been ignored as well. Their study compares the treatment effect on earnings, but does not investigate how far the treatment lifts the "ex-abuser's" wage toward the level of a non-user. If, for example, a user's wage was degraded by 0.2% and the treatment, as shown in Table 33, increased the person's wage by 0.16%, s/he is still 0.04 % below the non-user's wage. In this case, a "true" degradation factor of -0.04 % should be applied in a cost-benefit analysis.

Study	Explanatory Variable	Percent Difference in Wage Associated With Explanatory Variable [a]	
		Low Estimate	High Estimate
Harwood, et al. (1984)	Marijuana use	-0.279	-0.400
French, et al. (1990) [b]	Received treatment	+0.060	+0.160
Register and Williams (1992)	On-the-job marijuana use	-0.726	---
Register and Williams (1992)	Long-term marijuana use	-0.169	---
Register and Williams (1992)	Cocaine use	0	---
	Lifetime cocaine use	-0.137	-0.224
	New cocaine user	-0.225	---
	Past 30-day cocaine use	-0.940	-0.106
	Lifetime marijuana use	-0.790	-0.086
Kaestner (1984)	New marijuana use	-0.523	---
Mullahy and Sindelar (1993)	Alcoholism	-0.188	-0.369
Mullahy and Sindelar (1994)	Alcoholism	-0.220	-0.290

Source: Borack, Jules I., Mehay, Stephen L. "A Conceptual Model for Determining an Optimal Drug Testing Program". Navy Personnel Research and Development Center, San Diego, CA. January 1996.

[a] Each study uses a different methodology to obtain the low and high estimates: approaches include using different data sets (e.g., cross sectional vs. panel data), different estimators (e.g., fixed effects vs. simple ordinary least squares), and different model specifications, among others.

[b] French et al. (1990) examine the effect of receiving treatment on the difference between pre- and post-treatment earnings.

Table 33. Alternative Estimates of Effect and Drug and Alcohol Abuse on Male Wages.

A degradation factor of zero, according to the study by Register & Williams [Ref. 41] on cocaine use, seems unreasonable because the majority of studies on this subject have found some effect. Therefore, this study has been disregarded. Nevertheless, in the following sensitivity analysis, an extreme factor such as zero is considered.

In this part of the thesis, market wage differences will be used as a measure of how far and to what extent an employee's wage degrades due to drug use. That is, what

effect does using drugs have on productivity of drug users compared to non-users? The underlying assumption of this approach is that a drug user's marginal product (MP), although positive, is degraded by his or her drug usage.

The degradation factor (d) can be viewed as a tax on output: [Ref. 36]

$$MP_a = MP_p * (1-d)$$

<u>where</u>: MP_a = actual marginal product

MP_p = perceived marginal product

d = degradation factor

Because the Navy's output is intangible, Navy personnel are paid on the basis of perceived rather than actual productivity. Perceived productivity, however, is assumed to be observable and equal to regular military compensation (RMC). Therefore, the equation above can be rewritten as follows:

$$MP_a = RMC * (1-d)$$

<u>where:</u> RMC = regular military compensation

The difficult task in cost-benefit analysis is to identify the magnitude of the true degradation factor (d), for the reasons mentioned. As a result the following assumptions for the analysis were made.

From Table 33 the degradation factors from the various prior studies range from approximately zero to as high as 0.726. Ignoring the studies by Mullahy and Sindelar (1993, 1994) as well as the studies by French et al. (1990) does not affect the range of estimates. From the remaining studies, the lowest estimate of 0.079 (Register & Williams, for lifetime cocaine use) and the highest estimate of 0.726 (also Register & Williams for on-the-job marijuana use) were selected in order to get a lower-bound and upper-bound estimate of the degradation factor. Furthermore, a value of 0.2420, derived as the mean effect from the remaining studies in Table 33, also was adopted.

2. Benefits from Detecting Drug Users

The primary analysis of the FY99 DMDC data set, described in the previous chapter, provides an insight into the distribution of drug users by paygrade. Since roughly 99% of the detected drug use occurs in the enlisted paygrades, E-1 through E-9, a weighted average annual RMC for FY99 is calculated for all paygrades. This is done using personnel inventories from the FY99 DMDC data set. The assumption here is that the available DMDC data set represents a sample of the actual target group at which the

policy aims. The calculation results in an average RMC of $22,745.

Table 34 summarizes the annual (and daily, based on the average civilian work year of 250 days) benefits to the Navy of discharging the 5,416 detected drug users (enlisted) in FY99, after applying the three different (low, mean, high) degradation factors.

		Degradation Factor		
		Low[a]	**Mean**[b]	**High**[c]
Annually	Per person	$ 1,797	$ 5,504	$ 16,513
	Full sample	$ 9,713,770	$ 29,811,200	$ 89,434,408
Daily	Per person	$ 7.20	$ 22.00	$ 66.10
	Full sample	$ 38,995	$ 119,152	$ 357,998

Notes: Average annual RMC = $ 22,745

N = 5,416

[a] Degradation factor (low) = -0.079

[b] Degradation factor (mean) = -0.242

[c] Degradation factor (high) = -0.726

Table 34. Annual/Daily Benefits to the Navy due to Detection Effect.

Unfortunately, the calculations in Table 34 must be adjusted for the following reasons. The Navy's end-strength (enlisted) on September 30, 1999 was 314,272 [Ref. 42]. In FY99, 5,416 Navy personnel were detected and discharged due to drug use, which results in an annual detection rate of 1.72%. This detection rate, however, cannot be treated as

the "true" detection rate, because to maintain end-strength the Navy must recruit 5,416 new enlistees to replace those discharged, and some drug users will be included among the new enlistments needed to replace the discharged personnel, thereby decreasing the net detection rate (1.72%). No observed information currently exists about the drug users that the enlistment process fails to detect upon entry. Hence, the assumption, made by Borack and Mehay, that approximately 4% of those who replace the discharged personnel are drug users, is adopted. Applying this percentage to the model, the "true" detection effect becomes:

$$5,446 * (1-0.04) = 5,199.$$

Table 35 presents the benefits to the Navy (compared to Table 34), after applying the adjusted detection effect.

		Degradation Factor		
		Low[a]	**Mean**[b]	**High**[c]
Annually	Per person	$ 1,797	$ 5,504	$ 16,513
	Full sample	$ 9,342,603	$ 28,615,296	$ 85,851,087
Daily	Per person	$ 7.2	$ 22	$ 66.1
	Full sample	$ 37,433	$ 114,378	$ 343,654

Notes: Average annual RMC = $ 22,745
N = 5,199
[a] Degradation factor (low) = -0.079
[b] Degradation factor (mean) = -0.242
[c] Degradation factor (high) = -0.726

Table 35. Annual Benefits to the Navy using the Adjusted Detection Effect.

3. Benefits from Deterring Potential Drug Users

The annual benefit of the program, associated with the deterrence effect, is computed as follows. The results from the previous chapter (Table 25) indicated that, given the current testing rate, the program results in a deterrence effect (for past year drug participation) of approximately 9.76 percentage points. This means that the usage rate with the "zero tolerance" policy is 9.76 percentage points lower than it otherwise would be (for ages 17-49). About 5% of the Navy personnel in 1995 used drugs within the past year. Thus, Navy personnel would have a usage rate of roughly 14.76 percentage points without the program.

The annual number of personnel deterred in FY99 due to the existing policy can be calculated by applying the deterrence effect of 9.76 percentage points to the end-strength on September 30, 1999 of 314,272 (enlisted) yielding 30,673 deterred users. Multiplying the total number of Navy personnel deterred in FY99 times the degradation factor times the average annual RMC, yields the annual benefits (cost avoided) from the deterrence effect. These benefits range from $55.1 million (low degradation factor) to $506.5 million (high degradation factor), with a

middle value of $168.8 million using the mean degradation factor.

Table 36 summarizes the benefits to the Navy, combining the benefits from the detection effect (Table 35) as well as the deterrence effect. As can be seen, depending on the magnitude of the estimated degradation factor, the total benefits to the Navy range from roughly $59.5 million (low degradation factor), to as high as $547.4 million (high degradation factor), averaging $182.6 million (mean degradation factor),

Benefits Detection Effect			**Benefits Deterrence Effect**			**Total Benefits**		
Degradation Factor			Degradation Factor			Degradation Factor		
Low[a]	Mean[b]	High[c]	Low[a]	Mean[b]	High[c]	Low[a]	Mean[b]	High[c]
$9.3	$28.6	$85.5	$55.1	$168.8	$506.5	$64.4	$197.4	$592.0

Notes:
Average annual RMC = $ 22,745
N (detection effect) = 5,199
N (deterrence effect) = 30,673
[a] Degradation factor (low) = -0.079
[b] Degradation factor (mean) = -0.242
[c] Degradation factor (high) = -0.726

Table 36. Total Benefit from Detection and Deterrence Effect (millions of dollars).

C. COST ANALYSIS

As calculated in the previous chapter, the replacement costs the Navy bears by discharging positive drug testers, rather than rehabilitating them, ranges from $71.1 million

(under the assumption of a 1 for 1 replacement) to as high as $177.1 million (under the agriculture replacement cost approach).

However, this is not the only cost the Navy absorbs. The drug-testing program incurs several administrative costs, including medical labs, salaries for the program employees, and administrative costs. In FY99 the Navy spent $17.5 million to administer the drug-testing program [Ref. 43]. Adding this program cost to the replacement costs results in an annual cost for FY99 ranging from approximately $88.6 million (under the assumption of a 1 for 1 replacement) to $194.6 million (under the agriculture replacement cost assumption).

Another cost that has to be added is the loss in worker productivity caused by compliance with the program. On average, Navy enlistees/officers are tested 2.4 times a year. It is assumed that providing the urine sample takes roughly 10 minutes. To calculate the loss in productivity, the number of times a sailor has to provide an urine sample (2.4) is multiplied by the time it takes to "produce" the sample (10 minutes) times the Navy's enlisted inventory in 1999 (313,272). This results in a loss of productivity of roughly 52,379 hours. Using the average RMC for FY99, the

average hourly wage (based on a 250 working-day year at 8 hours per day) is $11.37. Multiplying the loss in productivity times the hourly wage, yields the total cost due to lost productivity of test takers of $1.4 million. Summarizing the total costs to the Navy -- replacement costs, program costs, and costs resulting from lost productivity -- yields a total cost ranging from $90 million (under the assumption of a 1 for 1 replacement) to $196 million (under the agriculture replacement cost assumption). Table 37 summarizes the calculated costs to the Navy for FY99.

Assumption	Replacement Cost	Program Cost	Costs due to Productivity-Loss	Total Program-Cost
1 for 1	$71.1	$17.5	$1.4	$90
Agriculture	$177.1	$17.5	$1.4	$196

Notes: Average annual RMC = $ 22,745

Table 37. Summary Cost Calculations for FY99. Past Year Participation (millions of dollars).

Table 38 summarizes the total costs, gross, and net benefits using past year participation. Under the best case assumption that the program results in a "true" deterrence effect of 9.76 percentage points, the benefits of the program, under the "one-for-one" replacement methodology, results in a net loss of $25.6 million (low degradation

factor). As soon as the degradation factor exceeds 0.12, the program generates in a net benefit, rising to as much as $502.0 million (high degradation factor). Thus, 0.12 is the breakeven degradation factor. Under the agriculture approach, however, the program results in a net loss of $131.6 million (low degradation factor). The breakeven degradation factor becomes 0.24. Under the assumption of a mean degradation factor, the program results in a net benefit of $1.4 million; using the high degradation factor the program yields a net benefit of $396 million.

Replacement Assumption	Total Cost	Gross Benefits Degradation Factor			Net Benefit / Loss Degradation Factor		
		Low[a]	Mean[b]	High[c]	Low[a]	Mean[b]	High[c]
1 for 1	$ 90	$64.4	$197.4	$592.0	($25.6)	$107.4	$502.0
Agriculture	$ 196	$64.4	$197.4	$592.0	($131.6)	$1.4	$396.0

Notes:

Average annual RMC	= $ 22,745
N (replacement)	= 5,416
N (detection effect)	= 5,199
N (deterrence effect)	= 30,673
[a] Degradation factor (low)	= -0.079
[b] Degradation factor (mean)	= -0.242
[c] Degradation factor (high)	= -0.726

Table 38. Summary Cost-Benefit Analysis. Past Year Participation (millions of dollars).

As we have seen in Chapter II, the deterrence effect for the past month participation differs significantly from that of the past year participation. The estimated

deterrence effect is only -0.78 percentage points. About 3% of the Navy personnel in 1995 used drugs within the past year. Thus, Navy personnel would have a usage rate of roughly 3.78 percentage points, without the program. If we apply the deterrence effect for this drug measure to the calculations, we obtain the results in Table 39.

		Gross Benefits Degradation Factor			Net Benefit / Loss Degradation Factor		
Replacement Assumption	**Total Cost**	Low[a]	Mean[b]	High[c]	Low[a]	Mean[b]	High[c]
1 for 1	$90	$13.7	$42.1	$126.3	($76.3)	($47.9)	$36.3
Agriculture	$196	$13.7	$42.1	$126.3	($182.3)	($153.9)	($69.7)

Notes: All numbers in millions

Average annual RMC = $ 22,745

N (replacement) = 5,416

N (detection effect) = 5,199

N (deterrence effect) = 2,451

[a] Degradation factor (low) = -0.079

[b] Degradation factor (mean) = -0.242

[c] Degradation factor (high) = -0.726

Table 39. Summary Cost-Benefit Analysis. Past Month Participation (millions of dollars).

As can be seen from Table 39, the cost benefit analysis under both methodologies ("one-for-one" and "agriculture") results in net losses from $47.9 million up to $182.3 million for the low and mean degradation factors. The program starts to be beneficial as soon as the breakeven degradation factor of 0.52 is reached, resulting

in a net benefit of $36.3 million, using the "one for one" replacement cost assumption.

D. SENSITIVITY ANALYSIS

So far, this thesis chapter has shown that three factors drive the cost effectiveness of the Navy's prevention program: (1) the degradation factor (d), (2) the net detection effect, and (3) the deterrence effect. In addition, this thesis was unable to exactly pinpoint each of the main driving factors. In cases in which we face some uncertainty about the magnitude of the estimates, the cost-benefit literature suggests we conduct a partial sensitivity analysis in which the factors are changed over a predetermined range, one at a time, while holding the others constant [Ref. 44]. In the previous cost-benefit analysis, we used the most plausible estimates of these unknown factors, which form the base case in the following sensitivity analysis. Table 40 provides an overview of the base values and the chosen ranges, which we alter to re-estimate the net benefits for the past year and past month participation models.

Factor	Base Value			Range
	(Low)	(Mean)	(High)	
Degradation	-0.079	-0.242	0.726	0-0.7
Detection Effect	96%			94-98%
Deterrence Effect (Past Year)	9.76% points			6-10% points
Deterrence Effect (Past Month)	0.78% points			0-5% points

Table 40. Base Value and Range for Sensitivity Analysis. Past Year/Past Month Participation.

Since the cost-benefit calculations for both drug measures are the same and the chosen ranges are overlapping, the sensitivity calculations for past year and past month participation were combined. Furthermore, for the reasons described earlier in this chapter the sensitivity analysis is restricted to the agriculture approach only, because we believe it is more realistic.

The findings of the sensitivity analysis are summarized in Appendix Q. The analysis shows that the "true" detection rate, given the chosen range, is the parameter with the smallest impact on the net benefit outcome. Although the magnitude of the net benefits/net losses varies, the general combination of degradation factor and deterrence effect, at which the program

generates a positive net benefit, does not. The general combination is shown in Table 41.

Deterrence Effect (% points)	Degradation Factor							
	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
0	–	–	–	–	–	–	–	–
2	–	–	–	–	–	–	–	–
4	–	–	–	–	–	+	+	+
6	–	–	–	–	+	+	+	+
8	–	–	–	+	+	+	+	+
10	–	–	–	+	+	+	+	+
12	–	–	+	+	+	+	+	+
14	–	–	+	+	+	+	+	+
16	–	–	+	+	+	+	+	+
18	–	–	+	+	+	+	+	+
20	–	–	+	+	+	+	+	+

Notes: – indicates Net Loss
+ indicates Net Benefit

Table 41. Combined Sensitivity Analysis of Net Benefits (Agriculture Cost Approach).

If the deterrence effect ranges between zero and two percentage points, the magnitude of the degradation factor does not have enough weight to generate positive net benefits for the program. If the deterrence effect is 4%, the degradation factor must exceed 0.4 in order to produce a net benefit. A deterrence effect of 10% still requires a degradation factor of 0.3 to make the program beneficial. If the loss in productivity (degradation factor) lies somewhere below 20% (or 0.2), the deterrence effect must exceed 20% in order to result in a beneficial outcome of the program.

E. SUMMARY

This chapter has shown how complex and far-reaching the implementation and the enforcement of the Navy's "zero tolerance" policy is. As can clearly be seen from the cost-benefit analysis, the "true" magnitude of the degradation factor (d) and the deterrence effect are the main parameters in determining whether the program is cost effective. As summarized in Table 42, the result of the policy, based on the past year participation measure and the base values, can range from a net loss of $131.6 million to a net benefit of $ 502.0 million, depending on the degradation factor and the replacement methodology.

Replacement Assumption	Total Cost	Gross Benefits Degradation Factor			Net Benefit / Loss Degradation Factor		
		Low[a]	Mean[b]	High[c]	Low[a]	Mean[b]	High[c]
1 for 1	$ 90	$64.4	$197.4	$592.0	($25.6)	$107.4	$502.0
Agriculture	$ 196	$64.4	$197.4	$592.0	($131.6)	$1.4	$396.0

Notes:

Average annual RMC	=	$ 22,745
N (replacement)	=	5,416
N (detection effect)	=	5,199
N (deterrence effect)	=	30,673
[a] Degradation factor (low)	=	-0.079
[b] Degradation factor (mean)	=	-0.242
[c] Degradation factor (high)	=	-0.726

Table 42. Summary Cost-Benefit Analysis. Past Year Participation (millions of dollars).

Table 43 again summarizes the results of the policy. Based on the past month participation measure and the base values, the policy results in a range from a net loss of \$182.3 million to a net benefit of \$ 36.3 million.

Replacement Assumption	Total Cost	Gross Benefits Degradation Factor			Net Benefit / Loss Degradation Factor		
		Low[a]	Mean[b]	High[c]	Low[a]	Mean[b]	High[c]
1 for 1	\$90	\$13.7	\$42.1	\$126.3	(\$76.3)	(\$47.9)	\$36.3
Agriculture	\$196	\$13.7	\$42.1	\$126.3	(\$182.3)	(\$153.9)	(\$69.7)

Notes: All numbers in millions

Average annual RMC	= \$ 22,745
N (replacement)	= 5,416
N (detection effect)	= 5,199
N (deterrence effect)	= 2,451
[a] Degradation factor (low)	= -0.079
[b] Degradation factor (mean)	= -0.242
[c] Degradation factor (high)	= -0.726

Table 43. Summary Cost-Benefit Analysis. Past Month Participation (millions of dollars).

In addition, the sensitivity analysis conducted in this chapter has shown a clear and robust pattern within the chosen range for the values of the most important parameters. It has shown that the degradation factor is the main factor that impacts the beneficial outcome of the program. With the deterrence effects previously found in this thesis in mind, a relatively high degradation factor is necessary to justify the program. It should be noted however, that a degradation factor of 0.24 (or a

productivity loss of 24%), which is necessary under the agriculture approach for the past year participation model to result in a net benefit of zero (break even point), may be unrealistically high. The fact that the U.S. Navy must maintain a urinalysis program in order to identify illicit drug users suggests the consumption of drugs on the job does not manifest itself in ways that are readily observable by superiors or co-workers. This suggests that the true degradation factor may well be below 24%. If the actual loss in productivity were as high as 24%, a well-trained corps of senior officers and petty officers (the military leaders in a unit) should be able to identify which subordinates or peers are using drugs. Hence, a urinalysis test program would not be necessary.

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V. CONCLUSION AND RECOMMENDATION

A. CONCLUSION

The first research question posed by this thesis was: Did the implementation of the Navy's drug prevention policies achieve the desired results of minimizing drug use? The results of this research suggests that the implementation of the "zero tolerance" policy resulted in a positive deterrence effect for the Navy, ranging from 5.9 to 22.7 percentage points between 1979/80 and 1985, depending on which drug measure is used. Although the estimation for 1995 has shown the existence of a positive deterrence effect, the results indicate that the deterrence effect decreased between 1985 and 1995, ranging from 0.78 to 9.76 percentage points in 1995. It should be noted, however, that the estimated deterrence effect might be biased upward due to underreporting of the respondents in the military surveys. Therefore, the "true" deterrence effect may be lower than the estimates in this thesis. On the other hand, analysts have also pointed out that civilian drug use also may be underreported, so it is difficult to apply a simple adjustment factor for military underreporting.

Using a data file which contains socioeconomic information of Navy positive drug testers for FY99, the second research question this thesis attempted to answer was: What is the cost associated with the current "zero tolerance" policy? The thesis calculated the replacement cost of discharged personnel using two different approaches. The first assumed a "one-for-one" replacement, and the second used the "agriculture" replacement approach. The findings indicate that the replacement costs the Navy absorbed in FY99 ranged between $71.1 million (under the "one-for-one" replacement cost approach) to $177.1 million (under the "agriculture" replacement cost approach).

These cost estimates are rather conservative, since costs such as enlistment and reenlistment bonuses were omitted. Furthermore, salaries paid to the replacement person during the training period were not included in the replacement cost calculations. Based on a labor economics principle that trainees are paid above their marginal productivity during training periods, the salaries of trainees should be included as part of replacement cost. [Ref. 37] In addition, certain restrictions made in this thesis concerning the number of new accessions needed to replace discharges deliberately bias the calculated

replacement costs downward. As a result the true replacement costs can be assumed to be higher than those used in the thesis.

Finally, the last research question this thesis addressed was: What are the overall costs and benefits of the drug testing and "zero tolerance" program? The economic benefits to the Navy of discharging positive drug testers (detection effect) and deterring potential users (deterrence effect) were calculated and weighted against the total costs of the program (replacement costs, administrative program costs, and lost productivity). Total annual costs to the Navy range between $90 million (under the "one-for-one" replacement cost approach) to $196 million (under the "agriculture" replacement cost approach). Gross benefits range between $64 million and $592 million, for past year participation, depending on the replacement cost approach and the assumed productivity degradation factor. The gross benefits for past month participation range between $13.7 million and $126.3 million, again depending on the replacement cost approach and the assumed degradation factor. Hence, program net benefits range from a net loss of $131.6 million to a net benefit of $502 million using past year participation, and

range from a net loss of 182.3 million to a net benefit of 36.3 million using past month participation.

The sensitivity analysis, conducted for the "agriculture" replacement cost approach, which we think is the more realistic one, shows that given the estimated deterrence effect range (0.78-9.76 percentage points), the breakeven degradation factor is 0.24. This is the point at which the program begins to generate positive net benefits. However, this degradation factor may be unrealistically high. As pointed out before, the fact that the U.S. Navy must maintain a urinalysis program in order to identify illicit drug users suggests that their drug consumption on the job does not manifest itself in ways that are readily observable by superiors or co-workers. Thus, one can conclude that the true degradation factor is well below 0.24. If the actual loss in productivity were as high as 0.24, a well-trained corps of senior officers and petty officers (the military leaders in a unit) should be able to identify which subordinates or peers are using drugs. Hence, a urinalysis test program would not be necessary.

B. RECOMMENDATION

Although the cost-benefit analysis shows that the current "zero tolerance" policy may generate negative net

benefits to the Navy, the analysis must also consider other non-monetary and largely non-quantifiable effects of the drug prevention policies. One can argue that an organization, such as the Navy, which "produces" an outcome such as military readiness, must be held to higher standards than the civilian sector of society.

The illicit use of drugs must further be seen and treated as unacceptable for the following reasons: First, unlike most of the civilian occupations, the military's intangible output relies heavily on teams and units rather than individuals. No matter how severe or minor drug use actually reduces the individual's productivity, it can have a significant impact on the team/unit. The degradation of an individual (i.e. absenteeism), caused by drug use, is likely to degrade the unit's readiness, which can delay or prevent the deployment of an entire unit or weapon system (i.e. ship or squadron). Second, decreased productivity can cause repair times to slow down and thereby hamper a unit's ability to fulfill its mission. [Ref. 25] Third, military personnel work in ratings or commands, where safety is extremely important. Even small accidents, resulting from drug use, are likely to increase the risk of injury or death not only to the individual but also to coworkers (see

example USS NIMITZ in Chapter I). Finally, the majority of military personnel work with very expensive, high technology equipment, including multi-million dollar aircraft or even multi-billion dollar ships and aircraft carriers. Even a single serious accident, associated with drug use, may impose heavy costs on the military. If for example the probability of an accident (p) for a drug user is five percent higher than that of a non-user and the damage costs are $10 million, the expected value of damage for a drug user is $500,000 ($E(D) = p*D$). Thus, the expected value of potential damage can be seen as costs avoided (benefit) to the military resulting from discharging positive drug testers and deterring others from using drugs. [Ref. 25]

The calculated costs (replacement costs, administrative costs and loss in human capital) associated with the current strict enforcement of the policy suggests, however that, given the difficulties of meeting enlistment and reenlistment goals, the Navy may need to re-evaluate the procedure of discharging positive drug testers. Prior to the implementation of the "zero tolerance" policy the Navy routinely attempted to rehabilitate drug and alcohol abusers. We therefore recommend an analysis of the cost-

effectiveness of a rehabilitation program for positive drug testers. Under the assumption of a prior study by French [Ref. 40] that treatment (rehabilitation) increases a drug user's productivity to or close to the level of a non-user, the cost-effectiveness analysis should calculate and weigh the costs of such a program against the benefits of preserving the Navy's investment in human capital.

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APPENDIX A. MEANS FROM 1979 NHSDA AND 1980 DODWWS

Variables	Variable Definitions	Military Means	Civilian Means
Past-Month Drug Participation	=1 if respondent reports using any illicit drug in the past month	0.175 (0.380)	0.227 (0.419)
Past-Year Drug Participation	=1 if respondent reports using any illicit drug in the past year	0.356 (0.479)	0.322 (0.467)
Married	=1 if respondent is married	0.522 (0.500)	0.478 (0.500)
High School Diploma	=1 if respondent has high school diploma	0.417 (0.493)	0.345 (0.478)
Some College	=1 if respondent attended college but did not attain diploma	0.310 (0.463)	0.237 (0.425)
College Graduate	=1 if respondent has college degree	0.138 (0.345)	0.149 (0.356)
Age 17 - 20	=1 if respondent's age (in years) falls in category	0.210 (0.407)	0.246 (0.431)
Age 21 - 25	=1 if respondent's age (in years) falls in category	0.352 (0.478)	0.277 (0.448)
Age 26 - 34	=1 if respondent's age (in years) falls in category	0.276 (0.447)	0.230 (0.421)
Age 35 - 49	=1 if respondent's age (in years) falls in category	0.162 (0.368)	0.247 (0.431)
Black	=1 if respondent is Black , Negro or African American	0.176 (0.381)	0.109 (0.311)
Hispanic	=1 if respondent is Hispanic	0.048 (0.214)	0.049 (0.216)
Other Minority	=1 if respondent is other racial / ethnic minority	0.030 (0.170)	0.030 (0.170)
Female	=1 if respondent is female	0.089 (0.285)	0.544 (0.498)

Note: Restricted to ages 17 -49.
Military sample = 15,268; civilian sample = 4,624
Standard Deviation in parenthesis
Including officers and professionals

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APPENDIX B. MEANS FROM 1995 NHSDA AND DODWWS

Variables	Variable Definitions	Military Means	Civilian Means
Past-Month Drug Participation	=1 if respondent reports using any illicit drug in the past month	0.022 (0.147)	0.099 (0.299)
Past-Year Drug Participation	=1 if respondent reports using any illicit drug in the past year	0.047 (0.212)	0.171 (0.376)
Married	=1 if respondent is married	0.658 (0.474)	0.417 (0.493)
High School Diploma	=1 if respondent has high school diploma	0.293 (0.455)	0.325 (0.469)
Some College	=1 if respondent attended college but did not attain diploma	0.436 (0.496)	0.225 (0.418)
College Graduate	=1 if respondent has college degree	0.246 (0.431)	0.166 (0.372)
Age 17 - 20	=1 if respondent's age (in years) falls in category	0.100 (0.300)	0.180 (0.384)
Age 21 - 25	=1 if respondent's age (in years) falls in category	0.230 (0.421)	0.197 (0.398)
Age 26 - 34	=1 if respondent's age (in years) falls in category	0.274 (0.446)	0.409 (0.492)
Age 35 - 49	=1 if respondent's age (in years) falls in category	0.395 (0.489)	0.214 (0.410)
Black	=1 if respondent is Black , Negro or African American	0.166 (0.372)	0.240 (0.427)
Hispanic	=1 if respondent is Hispanic	0.083 (0.275)	0.271 (0.444)
Other Minority	=1 if respondent is other racial / ethnic minority	0.065 (0.247)	0.028 (0.165)
Female	=1 if respondent is female	0.184 (0.388)	0.612 (0.487)

Note: Restricted to ages 17 -49.
Military sample = 16,058; civilian sample = 12,012
Standard Deviation in parenthesis
Including officers and professionals

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APPENDIX C. SAS CODE FOR THE 1979 NHSDA AND 1980 DODWWS

```
****************************************;
*****   RESTRICTED TO AGE 17-49    ****;
*****************************************;
*****  CODE FOR 1980 DODWWS DATA    *****;
*****************************************;

DATA DOD (KEEP = DRUG30 DRUG12 MALE FEMALE
          SINGLE MARRIED WHITE BLACK HISPANIC OTHRACE AGE1
          AGE2 AGE3 AGE4 NOHSDG HSDG SOMCOLL COLLGRAD
          MIL PAYGRADE Q41A Q41B Q41C Q41D Q41E Q41F Q41G Q41H Q41I
          Q5 AGE RAETHNIC);

   LENGTH DRUG30 DRUG12 MIL MALE FEMALE
          SINGLE MARRIED WHITE BLACK HISPANIC OTHRACE AGE1
          AGE2 AGE3 AGE4 NOHSDG HSDG SOMCOLL COLLGRAD
          PAYGRADE Q41A Q41B Q41C Q41D Q41E Q41F Q41G Q41H Q41I
          AGE RAETHNIC 2;
    SET SASIN1.WWD80;
MIL=1 ;
***** DELETING OFFICERS *****;
IF PAYGRADE = 10 OR
   PAYGRADE = 11 OR
   PAYGRADE = 12 OR
   PAYGRADE = 13 OR
   PAYGRADE = 14 OR
   PAYGRADE = 15 THEN DELETE;
*****     CREATING DUMMY VARIABLES      *****:
*****     RECODING 30 DAY DRUG USE VARIABLE      *****;
IF DRUG30 = 1 THEN DRUG30 =1;
   ELSE DRUG30 = 0;
*****     RECODING 1 YEAR DRUG USE VARIABLE      *****;
IF (Q41A GE 2 AND Q41A LE 6) OR
   (Q41B GE 2 AND Q41B LE 6) OR
   (Q41C GE 2 AND Q41C LE 6) OR
   (Q41D GE 2 AND Q41D LE 6) OR
   (Q41E GE 2 AND Q41E LE 6) OR
   (Q41F GE 2 AND Q41F LE 6) OR
   (Q41G GE 2 AND Q41G LE 6) OR
   (Q41H GE 2 AND Q41H LE 6) OR
   (Q41I GE 2 AND Q41I LE 6) THEN DRUG12 = 1;
   ELSE DRUG12 = 0;
*****     RECODING GENDER VARIABLE      *****;
IF SEX = 1 THEN MALE = 1;
     ELSE MALE = 0;
IF SEX = 2 THEN FEMALE = 1;
     ELSE FEMALE = 0;
*****     RECODING MARITAL STATUS VARIABLE      *****;
IF Q5 GE 2 AND Q5 LE 5 THEN SINGLE = 1;
     ELSE SINGLE = 0;
IF Q5 = 1 THEN MARRIED = 1;
     ELSE MARRIED = 0;
```

```
*****     RECODING ETHNIC RACE VARIABLE     *****;
IF RAETHNIC = 1 THEN WHITE = 1;
     ELSE WHITE = 0;
IF RAETHNIC = 2 THEN BLACK = 1;
     ELSE BLACK = 0;
IF RAETHNIC = 3 THEN HISPANIC = 1;
     ELSE HISPANIC = 0;
IF RAETHNIC = 4 THEN OTHRACE = 1;
     ELSE OTHRACE = 0;
*****     RECODING AGE VARIABLE INTO FINAL GROUPS     *****;
IF AGE GE 1 AND AGE LE 4 THEN AGE1 = 1;
     ELSE AGE1 = 0;
IF AGE GE 5 AND AGE LE 11 THEN AGE2 = 1;
     ELSE AGE2 = 0;
IF AGE GE 12 AND AGE LE 16 THEN AGE3 = 1;
     ELSE AGE3 = 0;
IF AGE GE 17 AND AGE LE 18 THEN AGE4 = 1;
     ELSE AGE4 = 0;
*****     RECODING EDUCATION VARIABLE     *****;
IF EDLEVEL IN (1,3) THEN NOHSDG = 1;
     ELSE NOHSDG = 0;
IF EDLEVEL = 2 THEN HSDG = 1;
     ELSE HSDG = 0;
IF EDLEVEL = 4 OR
   EDLEVEL = 5 THEN SOMCOLL = 1;
     ELSE SOMCOLL = 0;
IF EDLEVEL = 6 OR
   EDLEVEL = 7 OR
   EDLEVEL = 8 THEN COLLGRAD = 1;
     ELSE COLLGRAD = 0;
****************************************;
*****  CODE FOR 1979 NHSDA DATA   *****;
****************************************;
DATA NHSDA (KEEP = DRUG30 DRUG12 CIV MALE FEMALE
          SINGLE MARRIED WHITE BLACK HISPANIC OTHRACE AGE1
          AGE2 AGE3 AGE4 NOHSDG HSDG SOMCOLL COLLGRAD
          ROCCUP2 PROF IRAGE IRSEX IRMARIT);

          LENGTH DRUG30 DRUG12 CIV MALE FEMALE
          SINGLE MARRIED WHITE BLACK HISPANIC OTHRACE AGE1
          AGE2 AGE3 AGE4 IRAGE NOHSDG HSDG SOMCOLL COLLGRAD
          ROCCUP2 PROF 2;
  SET SASIN2.NHSDA79;
CIV = 1 ;
*****     CREATING DUMMY VARIABLES     *****:
*****     RECODING 30 DAY DRUG USE VARIABLE     *****;
IF SUMMON = 1 THEN DRUG30 = 1;
     ELSE IF SUMMON = 0 THEN DRUG30 = 0;
*****     RECODING 1 YEAR DRUG USE VARIABLE     *****;
IF SUMYR = 1 THEN DRUG12 = 1;
     ELSE IF SUMYR = 0 THEN DRUG12 = 0;
*****     RECODING GENDER VARIABLE     *****;
IF IRSEX = 1 THEN MALE = 1;
     ELSE MALE = 0;
IF IRSEX = 2 THEN FEMALE = 1;
     ELSE FEMALE = 0;
```

```
*****     RECODING MARITAL STATUS VARIABLE     *****;
IF IRMARIT = 1 THEN MARRIED = 1;
     ELSE MARRIED = 0;
IF IRMARIT = 2 OR
   IRMARIT = 3 OR
   IRMARIT = 4 OR
   IRMARIT = 5 THEN SINGLE = 1;
     ELSE SINGLE = 0;
*****     RECODING ETHNIC RACE VARIABLE     *****;
IF RACE = 1 THEN WHITE = 1;
     ELSE WHITE = 0;
IF RACE = 2 THEN BLACK = 1;
     ELSE BLACK = 0;
IF RACE = 3 THEN HISPANIC = 1;
     ELSE HISPANIC = 0;
IF RACE = 4 THEN OTHRACE = 1;
     ELSE OTHRACE = 0;
*****     RECODING AGE VARIABLE INTO FINAL GROUPS     *****;
IF IRAGE GE 17 AND IRAGE LE 20 THEN AGE1 = 1;
     ELSE AGE1 = 0;
IF IRAGE GE 21 AND IRAGE LE 25 THEN AGE2 = 1;
     ELSE AGE2 = 0;
IF IRAGE GE 26 AND IRAGE LE 34 THEN AGE3 = 1;
     ELSE AGE3 = 0;
IF IRAGE GE 35 AND IRAGE LE 49 THEN AGE4 = 1;
     ELSE AGE4 = 0;
*****     RECODING EDUCATION VARIABLE     *****;
IF EDUCCAT2 = 1 THEN NOHSDG =1;
     ELSE NOHSDG = 0;
IF EDUCCAT2 = 2 THEN HSDG = 1;
     ELSE HSDG = 0;
IF EDUCCAT2 = 3 THEN SOMCOLL = 1;
     ELSE SOMCOLL = 0;
IF EDUCCAT2 = 4 THEN COLLGRAD =1;
     ELSE COLLGRAD = 0;
***** SAS CODE TO CREATE DUMMY FOR PROF OCCUPS. *****;
IF ROCCUP2 IN (1,2) THEN PROF = 1;
     ELSE PROF = 0;
***** DELETING PROFESSIONALS *****;
IF PROF = 1 THEN DELETE;
************************************************************;
*****     CODE FOR COMBINED NHSDA DODWWS DATASETS     *****;
************************************************************;
DATA MERGE1;
SET DOD NHSDA;
DATA MERGE2;
     SET MERGE1;
* LIMIT AGE FROM 17 TO 49;
IF AGE1=1 OR AGE2=1 OR AGE3=1 OR AGE4=1;
IF CIV = 1 THEN CIVILIAN = 1;
     ELSE CIVILIAN = 0;
IF MIL = 1 THEN MILITARY = 1;
     ELSE MILITARY = 0;
PROC MEANS;
     VAR DRUG30 DRUG12 CIVILIAN FEMALE
         MARRIED BLACK HISPANIC OTHRACE AGE1 AGE2 AGE3
```

```
          MILITARY
          AGE4 HSDG SOMCOLL COLLGRAD;
WHERE MIL=1;
PROC MEANS;
     VAR DRUG30 DRUG12 CIVILIAN FEMALE
          MARRIED BLACK HISPANIC OTHRACE AGE1 AGE2 AGE3
          MILITARY
          AGE4 HSDG SOMCOLL COLLGRAD;
WHERE CIV=1;

PROC MEANS;
     VAR DRUG30 DRUG12 CIV FEMALE
          MARRIED BLACK HISPANIC OTHRACE AGE1 AGE2 AGE3 MIL
          AGE4 HSDG SOMCOLL COLLGRAD;
PROC TTEST;
  CLASS MILITARY;
     VAR DRUG30 DRUG12 HEAVY CIV MALE FEMALE SINGLE LITE
          MARRIED WHITE BLACK HISPANIC OTHRACE AGE1 AGE2 AGE3 MIL
          AGE4 NOHSDG HSDG SOMCOLL COLLGRAD;
PROC LOGISTIC DESCENDING DATA = MERGE2;
     MODEL DRUG12 = MILITARY FEMALE MARRIED BLACK HISPANIC
                    OTHRACE HSDG SOMCOLL COLLGRAD
                    AGE1 AGE2 AGE3;
PROC LOGISTIC DESCENDING DATA = MERGE2;
     MODEL DRUG30 = MILITARY FEMALE MARRIED BLACK HISPANIC
                    OTHRACE HSDG SOMCOLL COLLGRAD
                    AGE1 AGE2 AGE3;
*****     MARGINAL PROBABILITY LOGIT ANALYSIS     *****;
*****     BASE CASE     *****;
*****     CIVILIAN MALE SINGLE WHITE AGE4 HSDG  *****;
DATA TWO;
     INPUT MILITARY FEMALE MARRIED BLACK HISPANIC OTHRACE
           AGE1 AGE2 AGE3 HSDG SOMCOLL COLLGRAD;
     KEEPME = 1;
     CARDS;
 0 .196 .48 .18 .05 .03 .25 .36 .24 .45 .32 .04 * NOTIONAL
 1 .196 .48 .18 .05 .03 .25 .36 .24 .45 .32 .04 * MILITARY
 ;
DATA THREE;
     SET MERGE2 TWO;
PROC LOGISTIC DATA = THREE DESCENDING MAXITER = 250;
     MODEL DRUG12 = MILITARY FEMALE MARRIED BLACK HISPANIC OTHRACE
                    AGE1 AGE2 AGE3 HSDG SOMCOLL COLLGRAD;
     OUTPUT OUT = MARGDG12 P = YHAT;
   TITLE 'MARGINAL PROBABILITY LOGIT DRUG12';

PROC LOGISTIC DATA = THREE DESCENDING MAXITER = 250;
     MODEL DRUG30 = MILITARY FEMALE MARRIED BLACK HISPANIC OTHRACE
                    AGE1 AGE2 AGE3 HSDG SOMCOLL COLLGRAD;
     OUTPUT OUT = MARGDG30 P = YHAT;
   TITLE 'MARGINAL PROBABILITY LOGIT DRUG30';

PROC PRINT DATA = MARGDG12;
     VAR YHAT DRUG12 MILITARY FEMALE MARRIED BLACK HISPANIC
         OTHRACE AGE1 AGE2 AGE3 HSDG SOMCOLL COLLGRAD;
     WHERE (KEEPME = 1);
```

```
     TITLE 'PREDICTED PROBABILITIES MARGINAL EFFECTS DRUG12';
PROC PRINT DATA = MARGDG30;
     VAR YHAT DRUG30 MILITARY FEMALE MARRIED BLACK HISPANIC
         OTHRACE AGE1 AGE2 AGE3 HSDG SOMCOLL COLLGRAD;
     WHERE (KEEPME = 1);
     TITLE 'PREDICTED PROBABILITIES MARGINAL EFFECTS DRUG30';

*****     THIS IS THE LAST LINE OF THE PROGRAM     *****;
/*
//
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APPENDIX D. LOGIT ESTIMATES OF ANY ILLICIT DRUG PARTICIPATION, 1979/80, RESTRICTED SAMPLE, AGES 17-49

Variable	Past Year Participation	Past Month Participation
Military	0.0909	-0.503
	(0.0495)[a]	(0.0541)
	[1.998][b]	[-7.304]
Female	-0.493	-0.5191
	(0.0501)	(0.0584)
Married	-0.7976	-0.7094
	(0.0391)	(0.0475)
Black	-0.1419	-0.3981
	(0.0460)	(0.0554)
Hispanic	-0.0172	-0.2177
	(0.0767)	(0.0897)
Other Race	-0.311	-0.5824
	(0.1128)	(0.1490)
Age 17 - 20	2.7362	2.6181
	(0.0991)	(0.1391)
Age 21 - 25	2.6488	2.5535
	(0.0951)	(0.1359)
Age 26 - 34	1.5322	1.5402
	(0.0982)	(0.1412)
High School Diploma	-0.1456	-0.0639
	(0.0484)	(0.0538)
Some College	-0.1885	-0.0738
	(0.0534)	(0.0607)
College graduate	0.2424	0.2081
	(0.0997)	(0.1154)
Constant	-2.1439	-2.6484
	(0.11)	(0.14)
Log likelihood	19,228.87	15,485.14
N	17,266	17,266

Notes: Merged 1979 NHSDA 1980 DODWWS
[a] Standard errors are parentheses
[b] Marginal effects in brackets

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APPENDIX E. LOGIT ESTIMATES OF ANY ILLICIT DRUG PARTICIPATION, 1985, RESTRICTED SAMPLE, AGES 17-49

Variable	Past Year Participation	Past Month Participation
Military	-1.4752	-1.3407
	(0.0597)[a]	(0.0684)
	[-17.635][b]	[-11.08]
Female	-0.4219	-0.4435
	(0.0600)	(0.0692)
Married	-0.5623	-0.4572
	(0.0527)	(0.0623)
Black	-0.2281	-0.0771
	(0.0599)	(0.0683)
Hispanic	-0.514	-0.391
	(0.0731)	(0.0840)
Other Race	-0.525	-0.3791
	(0.1600)	(0.1860)
Age 17 - 20	1.834	1.6259
	(0.1064)	(0.1243)
Age 21 - 25	1.9	1.6735
	(0.0958)	(0.1125)
Age 26 - 34	1.3179	1.2129
	(0.0942)	(0.1104)
High School Diploma	-0.1244	-0.1205
	(0.6640)	(0.0755)
Some College	-0.1347	-0.2334
	(0.0731)	(0.0846)
College graduate	-0.3134	-0.35
	(0.1269)	(0.1478)
Constant	-1.5771	-2.0898
	(0.114)	(0.133)
Log likelihood	11,933.74	9,426.61
N	17,316	17,411

Notes: Merged 1985 NHSDA/ DODWWS
[a] Standard errors are parentheses
[b] Marginal effects in brackets

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APPENDIX F. LOGIT ESTIMATES OF ANY ILLICIT DRUG PARTICIPATION, 1995, RESTRICTED SAMPLE, AGES 17-49

Variable	Past Year Participation	Past Month Participation
Military	-1.3447 (0.0574)[a] [-10.65][b]	-1.4968 (0.0767) [-6.5198]
Female	-0.4417 (0.0492)	-0.534 (0.0626)
Married	-0.7165 (0.0554)	-0.8081 (0.0742)
Black	-0.2673 (0.0577)	-0.1618 (0.0724)
Hispanic	-0.6779 (0.0653)	-0.6345 (0.0836)
Other Race	-0.2166 (0.1184)	-0.0887 (0.1526)
Age 17 - 20	1.223 (0.0854)	0.9539 (0.1111)
Age 21 - 25	1.0833 (0.0807)	0.9188 (0.1064)
Age 26 - 34	0.6413 (0.0796)	0.6235 (0.1042)
High School Diploma	-0.1492 (0.0617)	-0.2499 (0.0762)
Some College	-0.2587 (0.0688)	-0.3234 (0.0856)
College graduate	-0.4952 (0.1096)	-0.9036 (0.1549)
Constant	-1.4642 (0.095)	-1.8822 (0.121)
Log likelihood	13,554.26	9,036.41
N	22,374	22,369

Notes: Merged 1995 NHSDA/DODWWS
[a] Standard errors are parentheses
[b] Marginal effects in brackets

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APPENDIX G. LOGIT ESTIMATES OF ANY ILLICIT DRUG PARTICIPATION, 1979/80, RESTRICTED SAMPLE, AGES 17-49, MALES ONLY

Variable	Past Year Participation	Past Month Participation
Military	-0.00946 (0.0611)[a] [-0.215][b]	-0.63 (0.0631) [-9.856]
Married	-0.784 (0.0441)	-0.6568 (0.0530)
Black	-0.0931 (0.0508)	-0.4217 (0.0610)
Hispanic	-0.0265 (0.0850)	-0.2466 (0.0989)
Other Race	-0.4539 (0.1257)	-0.8327 (0.1752)
Age 17 - 20	2.8237 (0.1132)	2.6563 (0.1589)
Age 21 - 25	2.7784 (0.1085)	2.6402 (0.1552)
Age 26 - 34	1.6077 (0.1115)	1.5638 (0.1607)
High School Diploma	-0.1844 (0.0541)	-0.0685 (0.0596)
Some College	-0.263 (0.0598)	-0.1125 (0.0676)
College graduate	0.083 (0.1193)	0.1123 (0.1388)
Constant	-2.1175 (0.123)	-2.5861 (0.166)
Log likelihood	15,338.04	12,467.38
N	13,723	13,723

Notes: Merged 1979 NHSDA and 1980 DODWWS
[a] Standard errors are parentheses
[b] Marginal effects in brackets

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APPENDIX H. LOGIT ESTIMATES OF ANY ILLICIT DRUG PARTICIPATION, 1985, RESTRICTED SAMPLE, AGES 17-49, MALES ONLY

Variable	Past Year Participation	Past Month Participation
Military	-1.5145	1.3768
	(0.0681)[a]	(0.0771)
	[-16.22][b]	[-9.516]
Married	-0.4589	-0.3464
	(0.0631)	(0.0745)
Black	-0.2513	-0.1221
	(0.0735)	(0.0838)
Hispanic	-0.3165	-0.2215
	(0.0896)	(0.1013)
Other Race	-0.5764	-0.411
	(0.1812)	(0.2088)
Age 17 - 20	1.9701	1.759
	(0.1234)	(0.1440)
Age 21 - 25	2.0047	1.8022
	(0.1081)	(0.1269)
Age 26 - 34	1.3243	1.2368
	(0.1061)	(0.1244)
High School Diploma	-0.1358	-0.1903
	(0.0828)	(0.0925)
Some College	-0.1454	-0.2828
	(0.0889)	(0.1009)
College graduate	-0.2838	-0.4061
	(0.1568)	(0.1820)
Constant	-1.6754	-2.1611
	(0.132)	(0.152)
Log likelihood	8,664.07	6,862.04
N	13,849	13,939

Notes: Merged 1985 NHSDA/DODWWS
[a] Standard errors are parentheses
[b] Marginal effects in brackets

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APPENDIX I. LOGIT ESTIMATES OF ANY ILLICIT DRUG PARTICIPATION, 1995, RESTRICTED SAMPLE, AGES 17-49, MALES ONLY

Variable	Past Year Participation	Past Month Participation
Military	-1.3867 (0.0687)[a] [-12.095][b]	-1.5984 (0.0899) [-7.963]
Married	-0.7183 (0.0727)	-0.8905 (0.0972)
Black	-0.089 (0.0771)	0.00194 (0.0954)
Hispanic	-0.4041 (0.0841)	-0.3905 (0.1058)
Other Race	-0.2498 (0.1487)	-0.1278 (0.1915)
Age 17 - 20	1.2307 (0.1140)	0.7761 (0.1448)
Age 21 - 25	1.1354 (0.1052)	0.8705 (0.1350)
Age 26 - 34	0.6982 (0.1046)	0.5737 (0.1335)
High School Diploma	-0.1216 (0.0843)	-0.2154 (0.1022)
Some College	-0.1788 (0.0936)	-0.1727 (0.1137)
College graduate	-0.4175 (0.1460)	-0.8392 (0.2006)
Constant	-1.597 (0.124)	-1.8774 (0.155)
Log likelihood	8,109.99	5,422.28
N	14,073	14,068

Notes: Merged 1995 NHSDA/DODWWS
[a] Standard errors are parentheses
[b] Marginal effects in brackets

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APPENDIX J. LOGIT ESTIMATES OF ANY ILLICIT DRUG PARTICIPATION, 1979/80, RESTRICTED SAMPLE, AGES 17-49, NAVY

Variable	Past Year Participation	Past Month Participation
Navy	0.2074 (0.0568)[a] [4.653][b]	-0.3419 (0.0618) [-5.248]
Female	-0.4791 (0.0504)	-0.508 (0.0587)
Married	-0.7761 (0.0396)	-0.6782 (0.0479)
Black	-0.1859 (0.0473)	-0.4095 (0.0568)
Hispanic	-0.0351 (0.0772)	-0.2207 (0.0900)
Other Race	-0.3492 (0.1126)	-0.6101 (0.1488)
Age 17 - 20	2.7221 (0.0993)	2.6031 (0.1392)
Age 21 - 25	2.6435 (0.0953)	2.5466 (0.1360)
Age 26 - 34	1.5315 (0.0984)	1.541 (0.1413)
High School Diploma	-0.1053 (0.0487)	-0.0398 (0.0540)
Some College	-0.1063 (0.0540)	-0.0106 (0.0612)
College graduate	0.2924 (0.1000)	0.2509 (0.1156)
Constant	-2.181 (0.107)	-2.6784 (0.145)
Log likelihood	19,085.99	15,404.33
N	17,266	17,266

Notes: Merged 1979 NHSDA 1980 DODWWS
[a] Standard errors are parentheses
[b] Marginal effects in brackets

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APPENDIX K. LOGIT ESTIMATES OF ANY ILLICIT DRUG PARTICIPATION, 1985, RESTRICTED SAMPLE, AGES 17-49, NAVY

Variable	Past Year Participation	Past Month Participation
Navy	-1.5191 (0.0813)[a] [-18.11][b]	-1.3336 (0.0944) [-11.181]
Female	-0.4144 (0.0602)	-0.4393 (0.0693)
Married	-0.5834 (0.0530)	-0.476 (0.0627)
Black	-0.2828 (0.0603)	-0.124 (0.0688)
Hispanic	-0.5477 (0.0729)	-0.4183 (0.0838
Other Race	-0.5466 (0.1607)	-0.3984 (0.1865)
Age 17 - 20	1.8169 (0.1068)	1.6141 (0.1247)
Age 21 - 25	1.9011 (0.0960)	1.6719 (0.1127)
Age 26 - 34	1.3039 (0.0943)	1.1992 (0.1105)
High School Diploma	-0.0931 (0.0662)	-0.0889 (0.0752)
Some College	-0.0582 (0.0733)	-0.1623 (0.0846)
College graduate	-0.2721 (0.1273)	-0.31 (0.1481)
Constant	-1.5709 (0.114)	-2.0856 (0.133)
Log likelihood	11,832.24	9,353.25
N	17,316	17,411

Notes: Merged 1985 NHSDA/DODWWS
[a] Standard errors are parentheses
[b] Marginal effects in brackets

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APPENDIX L. LOGIT ESTIMATES OF ANY ILLICIT DRUG PARTICIPATION, 1995, RESTRICTED SAMPLE, AGES 17-49, NAVY

Variable	Past Year Participation	Past Month Participation
Navy	-1.1429 (0.0816)[a] [-9.763][b]	-1.2604 (0.1111) [-6.0238]
Female	-0.4477 (0.0492)	-0.5385 (0.0626)
Married	-0.7088 (0.0555)	-0.7987 (0.0743)
Black	-0.2913 (0.0577)	-0.177 (0.0724)
Hispanic	-0.6901 (0.0653)	-0.644 (0.0835)
Other Race	-0.2502 (0.1186)	-0.1163 (0.1527)
Age 17 - 20	1.2359 (0.0857)	0.9652 (0.1114)
Age 21 - 25	1.1046 (0.0809)	0.9363 (0.1066)
Age 26 - 34	0.6553 (0.0798)	0.6374 (0.1043)
High School Diploma	-0.1546 (0.0617)	-0.2594 (0.0762)
Some College	-0.2284 (0.0687)	-0.2906 (0.0853)
College graduate	-0.4885 (0.1097)	-0.8958 (0.1549)
Constant	-1.4723 (0.095)	-1.8918 (0.121)
Log likelihood	13,453.73	8,980.18
N	22,374	22,369

Notes: Merged 1995 NHSDA/DODWWS
[a] Standard errors are parentheses
[b] Marginal effects in brackets

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APPENDIX M. LOGIT ESTIMATES OF ANY ILLICIT DRUG PARTICIPATION, 1979/80, RESTRICTED SAMPLE, AGES 17-49, NAVY MALES ONLY

Variable	Past Year Participation	Past Month Participation
Navy	0.1175 (0.0675)[a] [2.725][b]	-0.4646 (0.0703) [-7.712]
Married	-0.7579 (0.0446)	-0.6196 (0.0536)
Black	-0.1311 (0.0525)	-0.4294 (0.0627)
Hispanic	-0.041 (0.0856)	-0.2476 (0.0993)
Other Race	-0.5013 (0.1253)	-0.8664 (0.1749)
Age 17 - 20	2.8049 (0.1135)	2.6356 (0.1592)
Age 21 - 25	2.77 (0.1088)	2.6292 (0.1554)
Age 26 - 34	1.606 (0.1117)	1.5628 (0.1609)
High School Diploma	-0.1357 (0.0545)	-0.0389 (0.0598)
Some College	-0.168 (0.0606)	-0.392 (0.0684)
College graduate	0.1534 (0.1198)	0.1703 (0.1393)
Constant	-2.1531 (0.123)	-2.6119 (0.166)
Log likelihood	15,214.81	12,391.44
N	13,723	13,723

Notes: Merged 1979 NHSDA 1980 DODWWS
[a] Standard errors are parentheses
[b] Marginal effects in brackets

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APPENDIX N. LOGIT ESTIMATES OF ANY ILLICIT DRUG PARTICIPATION, 1985, RESTRICTED SAMPLE, AGES 17-49, NAVY MALES ONLY

Variable	Past Year Participation	Past Month Participation
Navy	-1.5539 (0.0915)[a] [-18.731][b]	-1.3649 (0.1050) [-11.583]
Married	-0.4804 (0.0636)	-0.3666 (0.0750)
Black	-0.3193 (0.0742)	-0.1819 (0.0845)
Hispanic	-0.3665 (0.0894)	-0.2617 (0.1010)
Other Race	-0.6026 (0.1821)	-0.4355 (0.2094)
Age 17 - 20	1.9506 (0.1240)	1.7467 (0.1446)
Age 21 - 25	2.0078 (0.1085)	1.8021 (0.1272)
Age 26 - 34	1.3052 (0.1063)	1.2184 (0.1245)
High School Diploma	-0.0804 (0.0825)	-0.1356 (0.0921)
Some College	-0.0345 (0.0892)	-0.178 (0.1011)
College graduate	-0.2063 (0.1579)	-0.3328 (0.1828)
Constant	-1.6755 (0.132)	-2.1651 (0.152)
Log likelihood	8,571.97	6,794.64
N	13,849	13,939

Notes: Merged 1985 NHSDA/DODWWS
[a] Standard errors are parentheses
[b] Marginal effects in brackets

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APPENDIX O. LOGIT ESTIMATES OF ANY ILLICIT DRUG PARTICIPATION, 1995, RESTRICTED SAMPLE, AGES 17-49, NAVY MALES ONLY

Variable	Past Year Participation	Past Month Participation
Navy	-1.2126 (0.0963)[a] [-11.165][b]	-1.3922 (0.1301) [-7.429]
Married	-0.7077 (0.0731)	-0.8777 (0.0975)
Black	-0.1215 (0.0771)	-0.0198 (0.0954)
Hispanic	-0.4205 (0.0840)	-0.4048 (0.1056)
Other Race	-0.298 (0.1489)	-0.1679 (0.1917)
Age 17 - 20	1.2558 (0.1146)	0.7985 (0.1455)
Age 21 - 25	1.1688 (0.1057)	0.8991 (0.1355)
Age 26 - 34	0.7257 (0.1049)	0.602 (0.1339)
High School Diploma	-0.127 (0.0842)	-0.2292 (0.1022)
Some College	-0.1322 (0.0934)	-0.1247 (0.1131)
College graduate	-0.4032 (0.1461)	-0.8267 (0.2007)
Constant	-1.621 (0.125)	-1.9002 (0.155)
Log likelihood	8,021.52	5,386.58
N	14,073	14,068

Notes: Merged 1995 NHSDA/DODWWS
[a] Standard errors are parentheses
[b] Marginal effects in brackets

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APPENDIX P. DMDC DATA FILE ON DISCHARGED NAVY PERSONNEL

				Educ.		Race	Primary	Duty	
Premise	Result	Grade	Sex	Cert	Age	Ethnic	MOS	Location	YOS
IR	THC	2	1	15	21	1	SA	34	2
VO	LSD	1	1	4	19	1	SR	9	1
NO	THC	1	1	1	18	1	AR	17	1
IU	BZE	2	1	15	20	1	STG0445	6	2
IR	AMP	2	2	15	22	1	SA	51	2
IR	MET	2	2	15	22	1	SA	51	2
PO	MET	3	1	8	28	1	HN 8404	6	2
IR	BZE	4	1	15	23	1	QM	51	5
NO	THC	1	1	15	19	1	SR	17	1
NO	THC	1	1	15	19	1	AR	17	1
CO	MDMA	4	1	15	26	1	RM	131	4
CO	MET	4	1	15	26	1	RM	131	4
IU	MET	5	1	15	31	1	MM 4513	254	12
IU	THC	4	1	15	22	1	HT 4954	0	3
VO	BZE	4	1	15	22	1	HT 4954	0	3
VO	THC	4	1	15	22	1	HT 4954	0	3
NO	AMP	1	1	15	19	1	SR	17	1
IU	THC	1	1	15	20	1	TM	51	2
NO	THC	1	1	1	18	1	SR	17	1
IR	BARB	4	1	15	22	1	OS	254	4
PO	THC	1	1	15	24	1	SR	254	1
IR	MET	5	1	15	33	1	AS 7607	6	12
IR	THC	5	1	15	33	1	AS 7607	6	12
IR	THC	2	1	15	23	1	SA	15	3
IU	THC	2	1	15	23	1	SA	6	3
NO	THC	1	2	4	20	1	AR	17	1
VO	THC	1	1	15	18	2	MS	51	1

Source: DMDC

Premise:

AC: Mishap Investigation (Pilot Tri-Service)
AO: Mishap/Safety/Accident (Pilot Tri-Service)
AT: Applicant Testing
CA: Civilian Mishap/Safety (Pilot Tri-Service)
CC: Command Directed (Pilot Tri-Service)
CD: CDR directed individual
CE: Civilian Preemployment (Pilot Tri-Service)
CO: Command Directed (Pilot Tri-Service)

CR:	Civilian Reasonable Suspicion (Pilot)
CT:	Civilian Random Testing (Pilot Tri-Service)
CV:	Civilian Volunteer (Pilot Tri_service)
IO:	Inspection Generic/Reenlist(Pilot Tri-Service
IR:	Random Sample (Pilot Tri-Service)
IU:	Unit Sweep (Pilot Tri-Service)
MC:	Medical (Pilot Tri-Service)
MO:	Medical (Pilot Tri-Service)
NO:	New Entrant/Officer Cand. (Pilot Tri-Service)
OF:	Field Test (Pilot Tri-Service)
OO:	Other Service Directed Test(Pilot Tri-Service
OS:	Other service directed
PC:	Probable Cause (Pilot Tri-Service Test)
PD:	Physician directed
PO:	Probable Cause (Pilot Tri-Service)
RC:	Rehab patient
RF:	Rehab staff
RO:	Rehabilitation (Pilot Tri-Service)
RP:	Rehab Patient (Pilot Tri-Service)
RS:	Rehab Staff (Pilot Tri_service)
US:	CDR direct unit
VO:	Consent Testing (Pilot Tri-Service)
ZZ:	Unknown or Invalid

Result:

AMP:	Amphetamine
BZE:	Cocaine
COC:	Cocaine
COD:	Codeine
DMET:	Designer Methampetamine
LSD:	Lysergic Acid Diethylamide
MDA:	Designer Amps
MDEA:	Designer Amps
MDMA:	Designer Amps
MET:	Methamphetamine
MOR:	Morphine
PCP:	Phencyclidine
THC:	Tetrahydrocannabinol
6MAM:	6-Acetylmorphine

Sex:

1:	male
2:	female

Pay Grade:

00:	Enlisted Unknown

01-09:	E01-E09
10:	Warrant Officer Unknown
11-15:	W01 - W05
20:	Commissioned Officer Unknown
21-31:	O01 - O11

Race/Ethnic:

0:	Unknown
1:	White
2:	Black
3:	Hispanic
4:	American Indian/Alaskan Native
5:	Asian/Pacific Islander
6:	Other

Educational Certificate:

0:	Unknown
1:	Less than High School (HS) diploma
2:	Currently in HS, not senior, alternative trng program
3:	HS senior
4:	Certificate of HS equivalent
5:	Certificate of completion of occupational program
6:	Certificate of attendance at an occupational program
7:	Successful completion of a HS homestudy correspondence course
8:	Adult Education diploma
9:	Certificate of HS attendance
10:	Home study diploma
15:	HS diploma
16:	NHS grad with one college semester completed
20:	First year college equivalent
21:	Associate degree
22:	Professional nursing diploma
23:	Baccalaureate
24:	Masters
25:	Post masters
26:	Doctorate
27:	First Professional

Source: DMDC

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APPENDIX Q. COMBINED SENSITIVITY ANALYSIS

Net Benefit/Loss (Net Detection Effect = 98%)

		Degradation Factor										
		0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Deterrence Effect (% points)	0	($196.0)	($184.0)	($171.9)	($159.8)	($147.7)	($135.7)	($123.6)	($111.5)	($99.5)	($87.4)	($75.3)
	2	($196.0)	($169.7)	($143.3)	($116.9)	($90.6)	($64.2)	($37.8)	($11.5)	$14.9	$41.3	$67.7
	4	($196.0)	($155.4)	($114.7)	($74.0)	($33.4)	$7.3	$48.0	$88.6	$129.3	$170.0	$210.6
	6	($196.0)	($141.1)	($86.1)	($31.1)	$23.8	$78.8	$133.7	$188.7	$243.7	$298.6	$353.6
	8	($196.0)	($126.8)	($57.5)	$11.7	$81.0	$150.3	$219.5	$288.8	$358.0	$427.3	$496.5
	10	($196.0)	($112.5)	($28.9)	$54.6	$138.2	$221.7	$305.3	$388.8	$472.4	$555.9	$639.5
	12	($196.0)	($98.2)	($0.3)	$97.5	$195.4	$293.2	$391.1	$488.9	$586.8	$684.6	$782.5
	14	($196.0)	($83.9)	$28.3	$140.4	$252.6	$364.7	$476.8	$589.0	$701.1	$813.3	$925.4
	16	($196.0)	($69.6)	$56.9	$183.3	$309.7	$436.2	$562.6	$689.1	$815.5	$941.9	$1,068.4
	18	($196.0)	($55.3)	$85.4	$226.2	$366.9	$507.7	$648.4	$789.1	$929.9	$1,070.6	$1,211.3
	20	($196.0)	($41.0)	$114.0	$269.1	$424.1	$579.1	$734.2	$889.2	$1,044.2	$1,199.3	$1,354.3

Net Benefit/Loss (Net Detection Effect = 96%)

		Degradation Factor										
		0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Deterrence Effect (% points)	0	($196.0)	($184.2)	($172.4)	($160.6)	($148.7)	($136.9)	($125.1)	($113.2)	($101.4)	($89.6)	($77.8)
	2	($196.0)	($169.9)	($143.8)	($117.7)	($91.5)	($65.4)	($39.3)	($13.2)	$12.9	$39.1	$65.2
	4	($196.0)	($155.6)	($115.2)	($74.8)	($34.4)	$6.1	$46.5	$86.9	$127.3	$167.7	$208.2
	6	($196.0)	($141.3)	($86.6)	($31.9)	$22.8	$77.5	$132.3	$187.0	$241.7	$296.4	$351.1
	8	($196.0)	($127.0)	($58.0)	$11.0	$80.0	$149.0	$218.0	$287.0	$356.1	$425.1	$494.1
	10	($196.0)	($112.7)	($29.4)	$53.9	$137.2	$220.5	$303.8	$387.1	$470.4	$553.7	$637.0
	12	($196.0)	($98.4)	($0.8)	$96.8	$194.4	$292.0	$389.6	$487.2	$584.8	$682.4	$780.0
	14	($196.0)	($84.1)	$27.8	$139.7	$251.6	$363.5	$475.4	$587.3	$699.2	$811.1	$923.0
	16	($196.0)	($69.8)	$56.4	$182.6	$308.8	$434.9	$561.1	$687.3	$813.5	$939.7	$1,065.9
	18	($196.0)	($55.5)	$85.0	$225.4	$365.9	$506.4	$646.9	$787.4	$927.9	$1,068.4	$1,208.9
	20	($196.0)	($41.2)	$113.5	$268.3	$423.1	$577.9	$732.7	$887.5	$1,042.3	$1,197.1	$1,351.8

Net Benefit/Loss (Net Detection Effect = 94%)

		Degradation Factor										
		0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Deterrence Effect (% points)	0	($196.0)	($184.4)	($172.9)	($161.3)	($149.7)	($138.1)	($126.6)	($115.0)	($103.4)	($91.8)	($80.2)
	2	($196.0)	($170.2)	($144.3)	($118.4)	($92.5)	($66.7)	($40.8)	($14.9)	$11.0	$36.9	$62.7
	4	($196.0)	($155.9)	($115.7)	($75.5)	($35.3)	$4.8	$45.0	$85.2	$125.3	$165.5	$205.7
	6	($196.0)	($141.6)	($87.1)	($32.6)	$21.8	$76.3	$130.8	$185.2	$239.7	$294.2	$348.7
	8	($196.0)	($127.3)	($58.5)	$10.3	$79.0	$147.8	$216.6	$285.3	$354.1	$422.8	$491.6
	10	($196.0)	($113.0)	($29.9)	$53.2	$136.2	$219.3	$302.3	$385.4	$468.5	$551.5	$634.6
	12	($196.0)	($98.7)	($1.3)	$96.0	$193.4	$290.8	$388.1	$485.5	$582.8	$680.2	$777.5
	14	($196.0)	($84.4)	$27.3	$138.9	$250.6	$362.2	$473.9	$585.5	$697.2	$808.8	$920.5
	16	($196.0)	($70.1)	$55.9	$181.8	$307.8	$433.7	$559.7	$685.6	$811.6	$937.5	$1,063.5
	18	($196.0)	($55.8)	$84.5	$224.7	$365.0	$505.2	$645.4	$785.7	$925.9	$1,066.2	$1,206.4
	20	($196.0)	($41.5)	$113.1	$267.6	$422.1	$576.7	$731.2	$885.8	$1,040.3	$1,194.8	$1,349.4

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